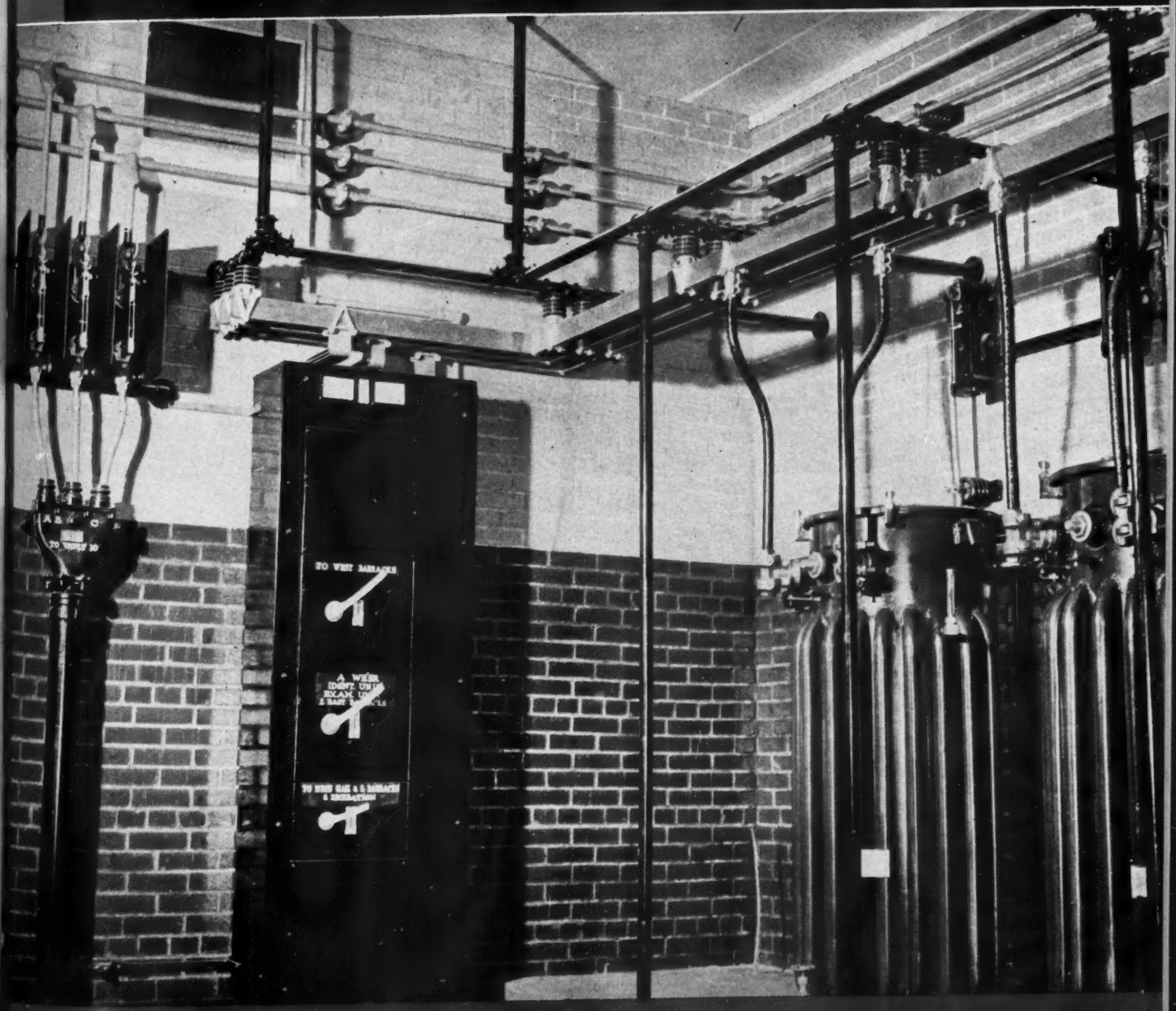
Electrical Contracting

AUGUST
1944

The Magazine of
ELECTRICAL CONSTRUCTION AND MAINTENANCE



IN THIS ISSUE... Labor hour data on branch circuit conduit installation... Hanger design and conduit layout for easy cleaning... Reconversion ideas from a changeover job... Wiring large power cranes... High voltage distribution methods at an air depot... How to apply wound rotor motors... and many practical methods and ideas.

A Compact Power Supply Right Where It's Wanted

Close to the load, yet out of the way

- ✓ NO OIL
- ✓ TOTALLY METAL ENCLOSED
- ✓ NO FIREPROOF VAULTS
- ✓ REMOTE MOUNTING UNNECESSARY
- ✓ NO LONG RUNS OF HEAVY COPPER

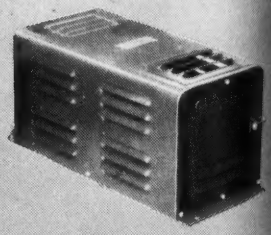
TUCKED AWAY UNDER THE EAVES at Kaiser Cargo, Inc., Shipyard No. 4, this 25-kva G-E dry-type transformer takes power from a 440-volt circuit and steps it down to operate 110- or 220-volt electric hand tools and lighting circuits, close by. The inherent safety that permitted it to be placed close to the load eliminated the need of long runs of heavy, expensive copper.

Installed right at the load, Type D transformers provide your equipment with the right voltage for its most economical operation. They are being used, profitably, from coast-to-coast in industrial plants to insulate one circuit from another and to boost or step down voltage for the most efficient operation of such equipment as motors, machine tools, welding apparatus, heat-treating furnaces, and high-current testing devices.

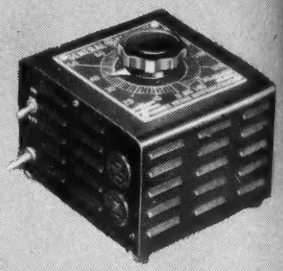
Stay cool; save space—Type D transformers are cooled by natural-draft ventilation. Their unique, drip-proof case, which incorporates a slanted-louver construction, aids the flow of ventilation air through the transformer coils. They can be placed against a wall or close to other units, with little or no effect on the temperature rise of the transformer. Because of this fact, considerable space can often be saved, especially when a number of these transformers are to be banked.

Easy to install; maintenance negligible—As these transformers are small, compact, and lightweight, they are easy to install on the floor, on the wall, or anywhere you wish. Either conduit or open wiring can be used. The ease of disassembly and reassembly of case parts permits quick inspection and cleaning, when necessary. But operating records show that little or no maintenance is required. Type D transformers are available in ratings up to 100 kva, 600 volts. For further information, ask for Bulletin GEA-897. *General Electric Company, Schenectady 5, N. Y.*

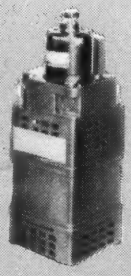
OTHER G-E AIDS TO BETTER VOLTAGE



VOLTAGE STABILIZER—Automatically provides a constant 115-volt supply to a given load, on circuits varying from 95 to 130 volts. Ratings from 50 to 5000 va. Ideal for precision laboratory or manufacturing processes, or built into such equipment as radio transmitters.



VARIABLE-VOLTAGE AUTO-TRANSFORMER—Provides smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243 to 810 va. Ideal for use in factories, laboratories, and assembled with other equipment.



AIR-COOLED REGULATORS—Automatic type: for secondary circuits (10% regulation, raise and lower). Remote-motor or hand operated: for laboratory or testing (100% raise and lower). Ratings up to 12 kva, 600 volts.

THE RIGHT VOLTAGE AT THE RIGHT PLACE DOES THE JOB **BETTER**

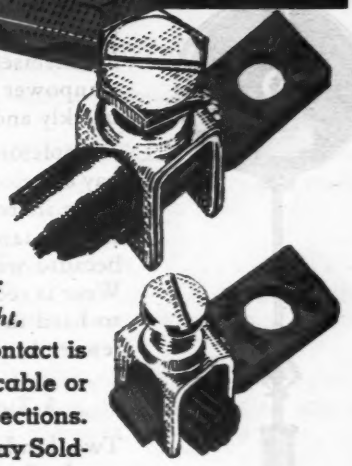
GENERAL ELECTRIC

403-71-5205, 5400

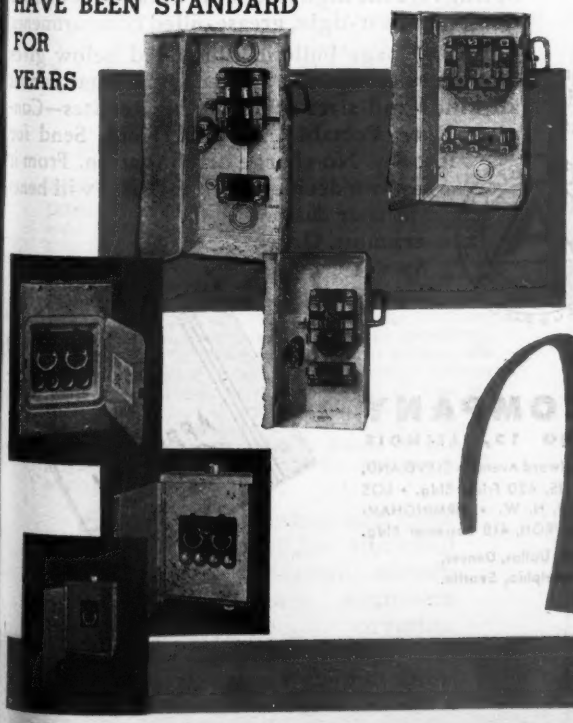
SOLDERLESS CONNECTORS THAT HOLD LIKE A VISE!

½" socket wrench for 3 larger sizes
Enormous pressure makes electrical contact absolute
Cable or wire can be inserted from any of 3 directions

FROM YOUR JOBBER — HE HAS THEM IN CONVENIENT, ECONOMY PACKAGES!



SOME FAMED MURRAY SWITCHES IN WHICH MURRAY SOLDERLESS CONNECTORS HAVE BEEN STANDARD FOR YEARS



So strong that they'll take all the tightening you will ever give them. When they're *tight*, they HOLD—and electrical contact is absolute. You can insert the cable or wire from any of *three* directions. These speedily-installed Murray Solderless Connectors have been standard in Murray Switches for years. Metropolitan Device Corporation, Brooklyn, N. Y.

SOLDERLESS CONNECTORS *by* Murray

METROPOLITAN DEVICE CORP. Brooklyn, N. Y.

Send price sheet and complete catalog of Solderless Connectors

Name _____

Address _____

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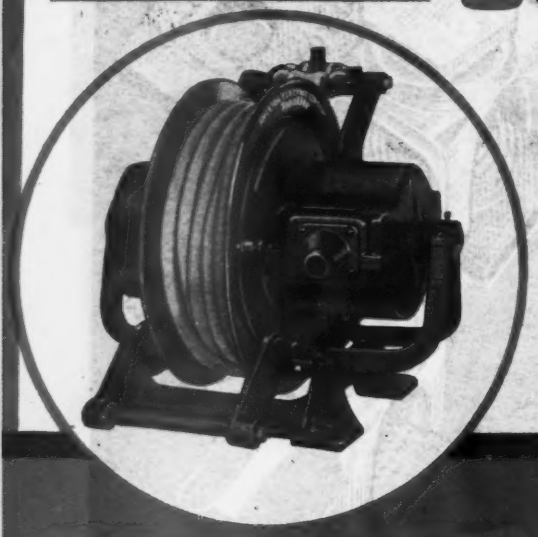
CONSTANT DUTY Reelite PORTABLE TYP

REG. U. S. PAT. OFF.



Type "C" Constant Duty Reelite equipped with Guide Roller Cable Outlet.

NO CABLE KINKS, TANGLES OR BREAK

Constant Current Plus Safet

A TYPE AND SIZE FOR EVERY NEED

Portable Type Reelite keeps light or power always within arm's reach. No time lost through untangling cord or plugging in socket.

Appleton Reelites provide electrical contractors, doing maintenance, with many opportunities to save money for their customers and make a profit for themselves. They do double duty now with manpower short, because they pay for themselves quickly and save labor.

Appleton Reelites automatically take up and pay out electric wires and cable to moving units. They increase man and machine productivity. Kinks, tangles and breaks just don't occur, because wires and cables are kept gently taut. Wear is reduced—of vital importance with cable so hard to get. Delays are avoided. Repairs are fewer. Accidents are prevented.

A Type and Size for Every Need

Two kinds of Appleton Reelites are manufactured—Constant Duty and Portable. Each is made in a particular type that provides top efficiency on a particular job.

Constant Duty Reelites are installed on cranes, hoists, elevators, stacking devices, machine tools, lifting magnets and similar equipment. Portable Reelites make light instantly available for dark corners of stores, offices, warehouses; and make power available for thousands of manufacturing operations.

For Air and Fluids

Special Reelites for use in the transmission of air and fluids also find a wide use. These Reelites work on the same spring-driven principle as the electric cable and cord types, and provide equal efficiency, economy and safety.

Appleton Quality and Dependability

Construction of Appleton Reelites is strong and rugged. Ball bearings eliminate undue wear and provide a lifetime of easy, trouble-free reeling. Springs are the highest quality obtainable and are housed in dust-tight, grease-filled compartments.

The 50 page bulletin illustrated below gives complete descriptions and technical details about all kinds and sizes of Appleton Reelites—Constant Duty, Portable, Air and Fluid. Send for it today. No charge or obligation. From it you can decide which Reelites will benefit your customers most. Or see Sweet's File, Page 2a/28.

APPLETON ELECTRIC PRODUCTS REG. U.S. PAT. OFF.

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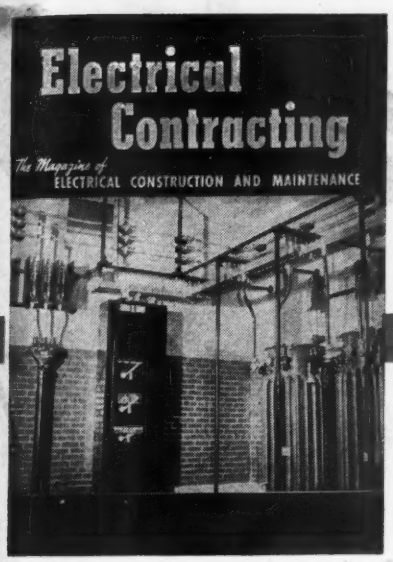

OUR COVER—Vault distribution showing primary and secondary bus work. Story on page 52.

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A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management in the field of electrical construction and maintenance.

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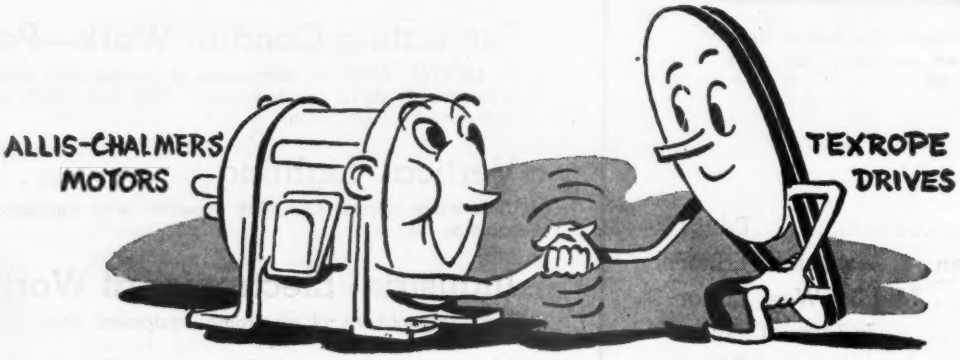
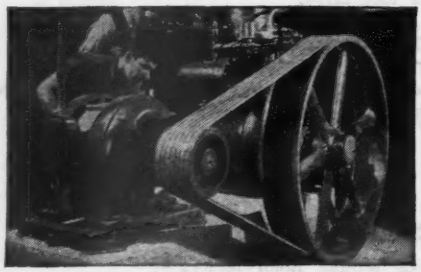
A-C "Team" Flexibility

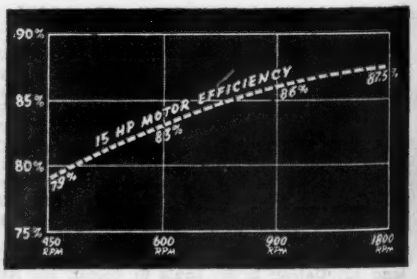


★ To drive low speed machinery with high speed motors (now that low speed motors are sharply restricted), Allis-Chalmers Texrope Drives can "gear down" motor speeds over a range of 7 to 1. As America's only builder of *both* motors and V-belt drives, Allis-Chalmers has long studied and advocated their use in proper com-



1 In most applications, an 1800 rpm motor with Texrope Drive will ably do the job of a lower-speed, direct-connected motor —at lower cost in money *and materials!*

2 When you buy an 1800 rpm instead of 450 rpm 15 hp squirrel-cage motor, for example, 600 lb are saved. And *you* save well over $200 — with drive figured in!



3 Note that efficiency rises from 79% for the 450 rpm motor to 87.5% for the 1800 rpm motor. The 1800 rpm motor saves you over 30 kw/24 hr. day.

ALLIS-C

Gives You now needed

bination . . . today offers you the benefit of long pioneering experience. Texrope Drives are compact, highly efficient, protect your equipment by absorbing shock.

★ To drive a machine at different rates with a single speed motor (now that multi-speed motors are sharply restricted), Texrope Adjustable-Speed Drives give you infinite speed range up to 375%. And in Allis-Chalmers full line of Texrope Drive equipment you'll find the *right* range for your machines . . . thus avoid paying extra for more speed than you need. For engineering cooperation, feel free to call on your nearby Allis-Chalmers district office or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

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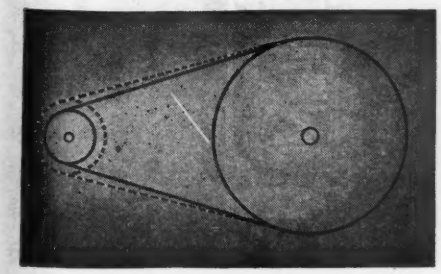
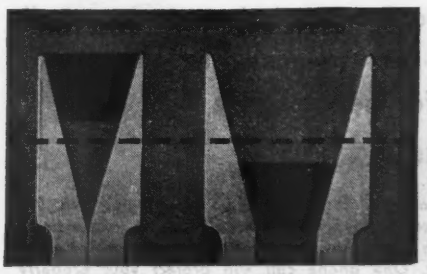


4 Infrequently needed speed changes can be had by changing from one size motor sheave to another. Juggling *complete* drives, range is 1:1 to 7:1.



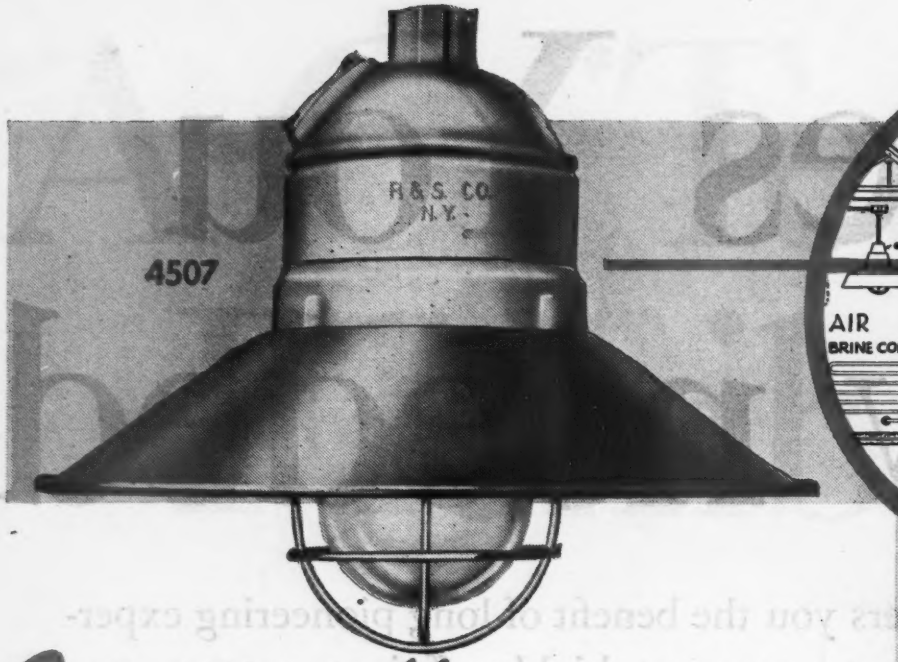
5 With the Allis-Chalmers Vari-Pitch Sheave, you can increase or decrease speed by adjusting sheave diameter . . . obtaining an *unbroken* series of speeds!

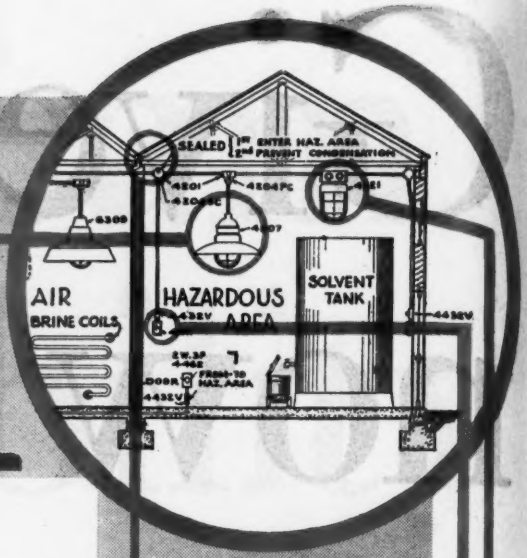
6 Allis-Chalmers Vari-Pitch Speed Changer gives you infinite changes at the turn of a wheel — within 3.75 to 1. It's compact, flexible, *efficient!*

CHALMERS

LO-MAINTENANCE MOTORS

TEXROPE DRIVES





Insure all Hazardous Areas

WITH R&S EXPLOSION-PROOF FIXTURES AND FITTINGS

The layout above shows how four R&S explosion-proof products meet the most exacting demands of safety in an extremely hazardous area.

WHEN YOU PLAN OR REMODEL a building, an outdoor installation, a ship or an electrical machine, it is not always possible to pre-determine the hazards it will encounter during its long life of service. With R&S, the electrical system can be made vaportight, dust-tight, moistureproof, waterproof or explosion-proof—or all five if necessary. And R&S Ever-Lok wiring devices will prevent accidental interruption of service for the life of the job.

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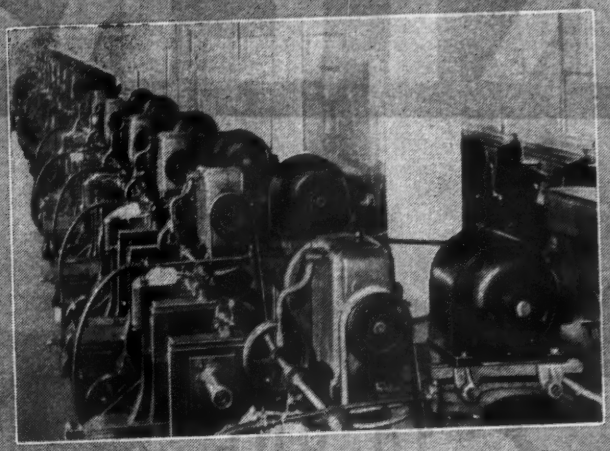
BEARINGS BEAR UP

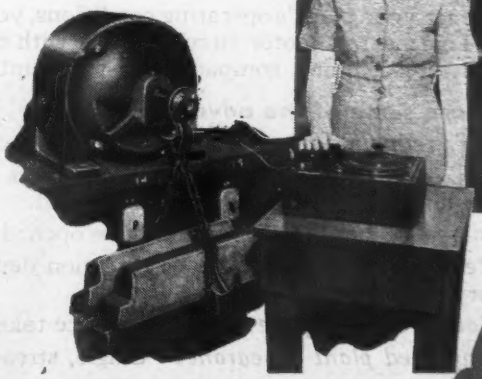


Powered by Tri-Clad sleeve-bearing motors, this battery of milling machines has been in round-the-clock operation on war work since before Pearl Harbor. The short-center, hinge-base drives put a hard, steady pull on the motor bearings. In addition, the machines are in the hands of several different operators each day, many newly trained. Despite the severe service, motor-bearing performance has been above prewar levels. Maintenance manpower has been conserved, and production held on schedule.

Tri-Clad motors driving milling machines in the River Plant Division of the Savage Arms Corp., Chicopee Falls, Massachusetts.

How torture tests on TRI/CLAD bearings have helped us lengthen motor life

Before the Tri-Clad motor-bearing designs were adopted, many models of this new motor were tested to destruction under heavy shaft loadings applied from all directions, with various kinds of lubricants, and under many different speed and temperature conditions. As new Tri-Clad types are introduced, these tests continue—some for years—in "torture" areas such as shown at right. Each test broadens our knowledge, offers new clues to longer motor life. Throughout industry, results have substantiated the improved bearing performance forecast by these tests. *General Electric Company, Schenectady 5, New York.*

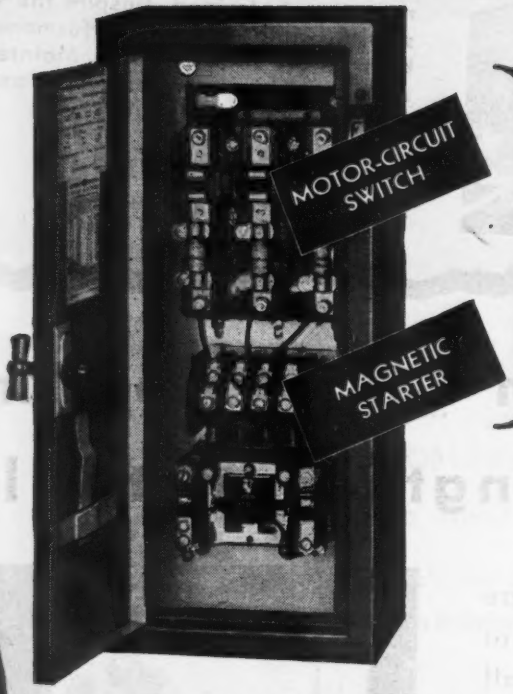


GENERAL ELECTRIC

TRI/CLAD MOTORS

Buy all the BONDS you can — AND KEEP ALL YOU BUY

MOTOR STARTERS



BOTH IN ONE UNIT

Showing door closed

USE COMBINATION STARTERS
to save time, save space, increase safety

Whatever your plant's operating conditions, you can get a combination control to fit it. This means a motor-circuit switch (with short-circuit protection) and a magnetic starter—in one, compact, easy-to-mount unit.

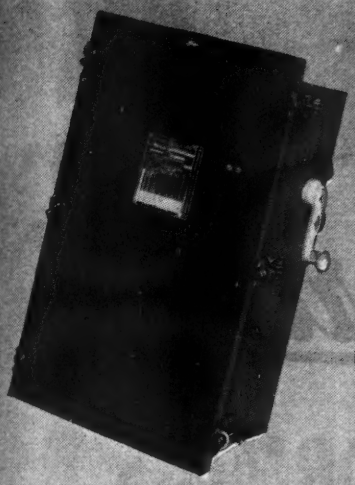
Here are some of the advantages

1. *50% reduction in mounting time*—You mount only one device, not two.
2. *40% reduction in wiring time*—Connect to only 9 terminals, not 15. The switch and starter come already connected.
3. *Increased safety*—Cover cannot be opened while there is power on the starter.
4. *Reliable motor protection*—Protection devices co-ordinated in starter at the factory.
5. *Saving of wall space*—The one device takes less space than two.
6. *Improved plant appearance*—Single, streamlined case—less open wiring and conduit.

GENERAL ELECTRIC

EVERY TYPE, EVERY KIND, FOR EVERY MACHINE APPLICATION

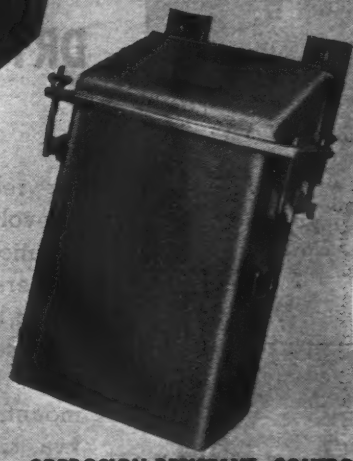
DEPENDABLE... ATTRACTIVE IN APPEARANCE... DESIGNED TO BLEND WITH MODERN MACHINES



DUST-TIGHT ENCLOSURES—For use in steel mills, cement mills, and other locations where the dust content of the atmosphere is heavy. The case is of heavy sheet metal, equipped with heavy gaskets, clamping bolts, and wing nuts.

GENERAL-PURPOSE STARTERS—Suitable for general-purpose, indoor applications where atmospheric conditions are normal.

WATERTIGHT ENCLOSURES—Suitable for outdoor use, and for damp places indoors, such as dairies, breweries, and ship docks. The case is of cast iron, or fabricated steel plate, with a special weatherproof finish and corrosion-proof fittings.



CORROSION-RESISTANT CONTROLLERS—Made in two forms—one for corrosive atmosphere and one for hazardous locations. All arcing parts and terminals (of forms for hazardous locations) are at least six inches under oil.

STARTERS FOR HAZARDOUS LOCATIONS—Made of cast, high-strength alloy. This starter is designed to withstand internal explosions. The flanges, which are securely bolted on all sides, are ground to tolerances which will not permit the escape of gases. General Electric Company, Schenectady 5, N. Y.

Which of these bulletins may we send you?

General Electric Company, Section B676-132, Schenectady 5, New York.

Please send me the bulletins checked below.

- ☐ GEA-3715 General-purpose, dust-tight and watertight starters
- ☐ GEA-3541 Corrosion-resistant controllers
- ☐ GEA-3804 Starters for hazardous locations

Name_____

Company_____

Address_____

City_____ State_____

Buy all the BONDS you can—and keep all you buy

One of the larger Standard Dry-Type Transformers. Class B insulation (fibre glass, mica, etc.)

Production Conversion Problems

made easier with

Standard

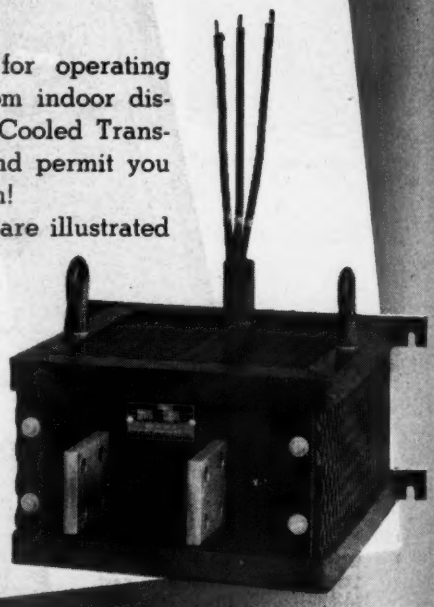
TRADE MARK

DRY-TYPE TRANSFORMERS

Wall mounting, air-cooled type with expanded metal protecting case. Popular for installation close to driven machine.

For relocating plant machinery, for operating low-voltage power and lighting from indoor distribution systems—STANDARD Air-Cooled Transformers save copper, save labor and permit you to get highest efficiency of operation!

Some of the more popular types are illustrated here. Floor, wall or overhead mounting, capacities up to 500 kva, single phase—1,000 kva, three phase—highest quality construction throughout. Special service on designs to suit your particular needs. Write for Bulletin S-202 today.



Specially designed and built to deliver heavy current from 115 volt circuit. Capacity, 3 kva. Standard has exceptional facilities for providing special designs and construction.

Typical weatherproof construction of Standard air-cooled transformer. Case is filled with moisture-proof compound which makes entire structure a solid unit.

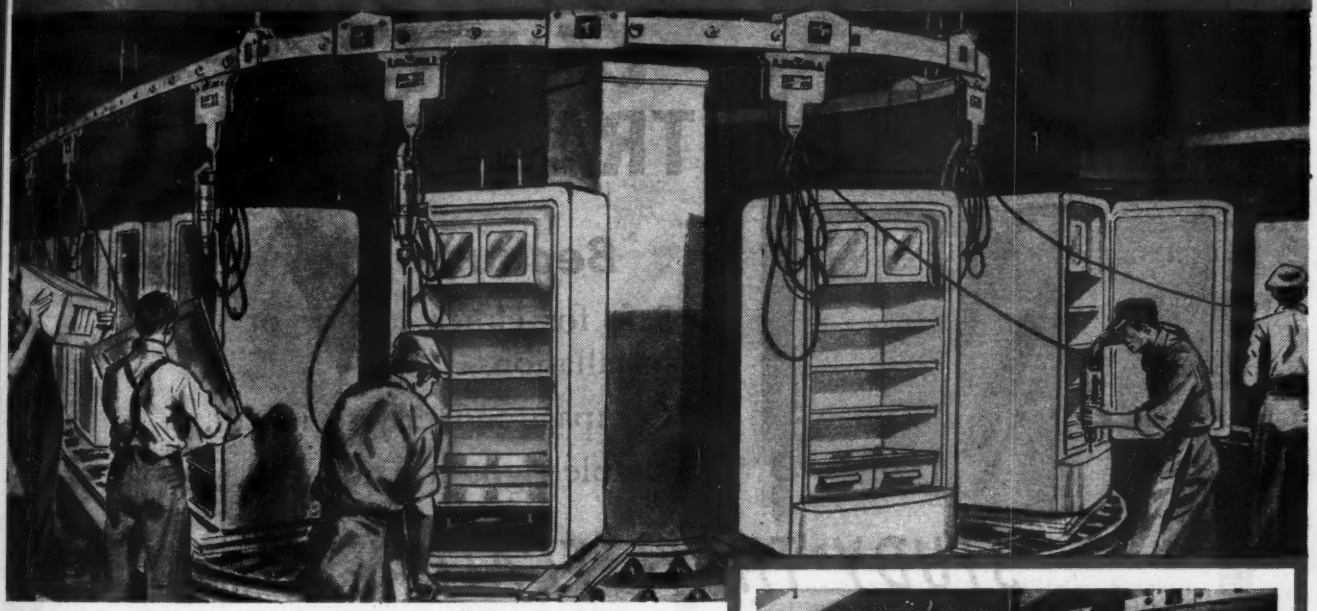
THE STANDARD TRANSFORMER COMPANY

Makers of Transformers for Distribution and Power, Metering, Street Lighting, Testing, Dry and Liquid Filled Types

WARREN, OHIO

Representatives in 29 Principal Cities

...BACK TO PEACETIME PRODUCTS



BullDog Will Speed Reconversion

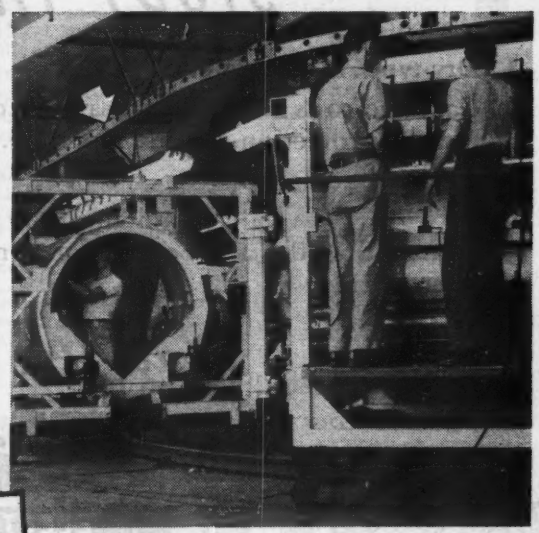
There's a big peacetime job ahead for portable tools, cranes, hoists and other "moving loads" . . . as big a job as they have had in the last three years of war production.

And, when reconversion starts, plants equipped with BullDog Industrial Trol-E-Duct will find their mobile power problems solved.

Only Industrial Trol-E-Duct has fully met the need for safe, convenient, flexible power that travels along with the tool or other moving load. Like other BullDog bus duct systems, it can be quickly moved to any location — readily adapted to any shop set-up.

We invite you to call on expert BullDog engineers for help in your reconversion planning — and we'll send descriptive folders promptly on request.

Help Invasion Roll—Buy More War Bonds



No more open trolley wires — no more long, dangling cords — with BullDog Industrial Trol-E-Duct. Safety goes up, production losses go down, and big savings are effected in wiring and fixed equipment. Not only as a feeder for portable tools on moving assembly lines, but also as a feeder for cranes and hoists—Industrial Trol-E-Duct is an indispensable helper in all kinds of plants.

BULLDOG
ELECTRIC PRODUCTS CO.

BOX 177, R. PK. ANNEX
DETROIT 32, MICHIGAN
BullDog Electric Products of Canada, Ltd., Toronto, Ont.

Field Engineering Offices in All Principal Cities

ALSO MANUFACTURERS OF
VACU-BREAK SAFETY SWITCHES • SWITCHBOARDS
• SAFTOFUSE PANELBOARDS
• CIRCUIT MASTER BREAKERS
• BUSDUCT SYSTEMS

It's to YOUR Advantage

to use Wagner Air-Cooled TRANSFORMERS

Because they are—

Safe for either indoor or outdoor installation.

Compact and easy to install.

Usable right at load.

STUDY THESE FEATURES:

1. Dry-type . . . no liquid.

2. Core and coils are vacuum treated in compound for protection against moisture.

3. Totally enclosed.

4. Provided with built-in junction box with knockouts on sides and bottom for conduit or open wiring.

5. Large removable coverplate of junction box assures ease in making connections.

6. Hanger-lugs designed for ease in mounting.

7. All ratings within the limits of the National Board of Fire Underwriters have the Underwriters' approval.

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ELECTRICAL AND AUTOMOTIVE PRODUCTS

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UNIT SUBSTATIONS
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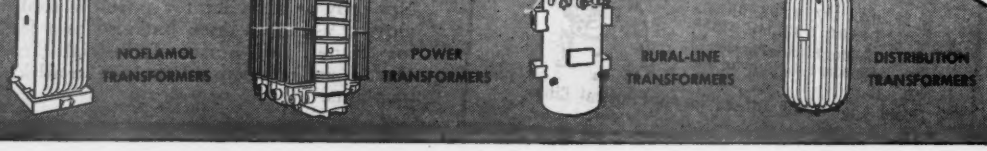
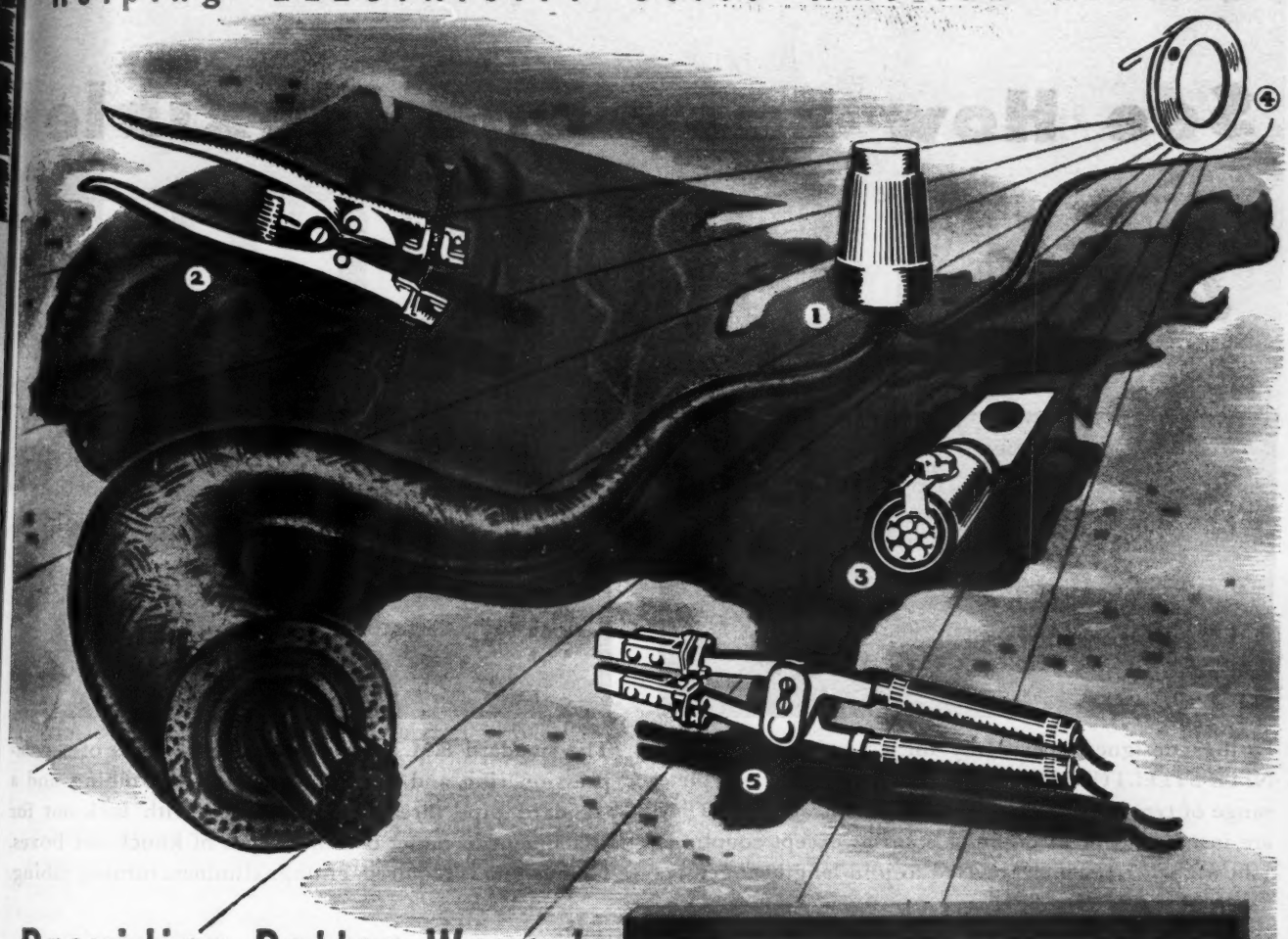
BRAKE LINING



Helping ELECTRICITY serve America better!



Providing Better Ways to **Wire-Up America!**

Wherever a motor turns—wherever electrical equipment speeds war production—wherever lights flood a factory, store building or home—many wire joints had to be made before these facilities could be used.

Probably no company has played a greater part than IDEAL in developing new and better ways of joining electrical wires together—more quickly—more safely—more economically.

But wiring devices are only a few of the more than ***100 products*** with which IDEAL is Helping Electricity Serve America Better.

To supply these products to more than ***40,000 customers,*** IDEAL has more than ***200 Service Engineers*** at industrial centers throughout the country—and keeps reserve stocks at the plant, in warehouses and with wholesalers in all principal cities.

Get the whole story of IDEAL Products and Service by sending for the free 88-page IDEAL Handbook today.

IDEAL *Sycamore*

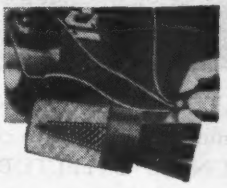
IDEAL COMMUTATOR DRESSER COMPANY
1941 Park Avenue ★ Sycamore, Illinois

OVER 100 PRODUCTS TO HELP ELECTRICITY SERVE BETTER

Shown above: (1) **IDEAL "WIRE-NUTS"** (Solderless, Tapeless Wire Connectors). (2) **IDEAL WIRE STRIPPERS,** Most Complete Line on the Market. (3) **LUGS** (Solder and Solderless). (4) **IDEAL FISH TAPE, REEL AND PULLER.** (5) **IDEAL ELECTRIC "THERMO-GRIP" PLIERS** with brazing attachment.

Other IDEAL Products: Motor Maintenance and Repair Equipment, Industrial Cleaners, Electric Marking Tools, Machine Tool Accessories, Fuse Devices, Safety Tools, Variable Speed Transmissions, etc.

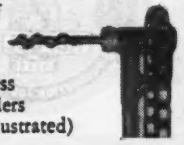
IDEAL "WIRE-NUTS" (Solderless, Tapeless Wire Connectors) are recognized as Standard throughout the Electrical Industry for Building Wiring, Industrial Plant Wiring, Joints in Electrical Equipment, etc. Proved to be most practical, lowest priced—and best joint, electrically and mechanically.



SOLD THROUGH JOBBERS

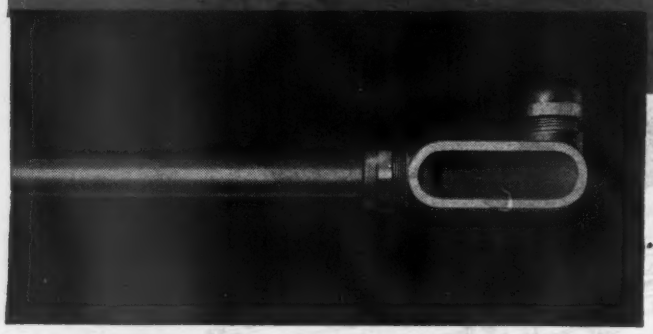
IDEAL RESISTANCE SOLDERING TOOLS have revolutionized soldering. A complete line of specialized tools for a wide variety of difficult soldering jobs. Instant Controlled Heat.

IDEAL Wiring Devices. Peace-Time or War-Time, wiring jobs must be finished fast in industrial plants and in construction. That is why each year more millions of these IDEAL Wiring Devices are used:—

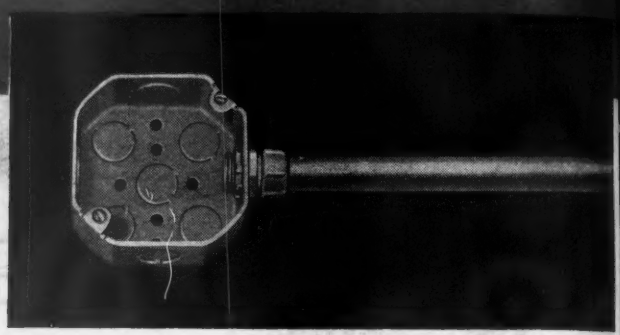


- IDEAL "Wire-Nuts"
- Lugs, Solder and Solderless
- Fish Tape, Reels and Pullers
- Joist Boring Machine (illustrated)

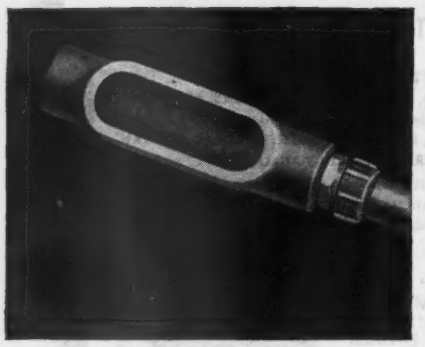
See How Easy and Flexible ... with ELECTRUNITE ...



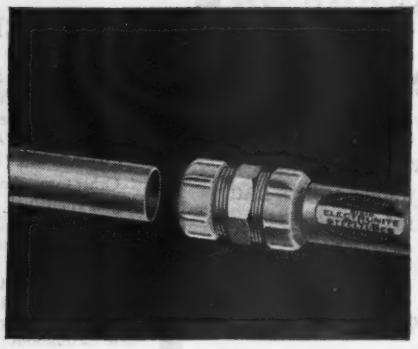
Fittings designed specifically for use with ELECTRUNITE STEELTUBES E.M.T. are available in a complete range of types and sizes from several manufacturers. They are installed without other accessories except couplings (shown below), which are used to join lengths together.



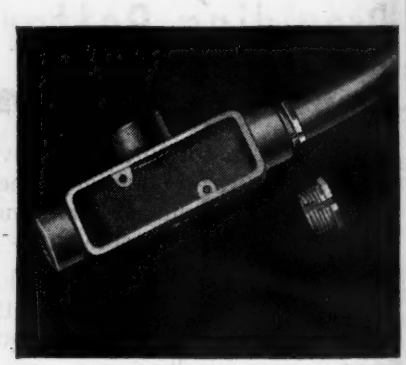
The standard E.M.T. box connector consists of a compression ring and nut for joining to the tubing and a standard pipe thread end furnished with lock-nut for attachment to outlet or other types of knock-out boxes. No bushing is required. Fittings eliminate turning tubing.



The E.M.T. box connector without the lock-nut may be used to connect ELECTRUNITE STEELTUBES to threaded conduit fittings.



Every E.M.T. coupling acts as a union. You don't turn the tube—just the nuts. No steel is exposed—no wrench marks damage the finish.



Threaded conduit fittings also can be installed with ELECTRUNITE STEELTUBES of corresponding size by use of this split adapter.

REPUBLIC STEEL — PRODUCTION FOR VICTORY

Republic "INCH-MARKED"

ELECTRUNITE Steeltubes

ELECTRICAL METALLIC TUBING MARKED WITH A CONTINUOUS FOOT-RULE

Raceway Installation Can Be Steeltubes

• You'll enjoy many distinct advantages when you use Republic "Inch-Marked" ELECTRUNITE STEELTUBES—and one of the most important is its ease and flexibility of installation.

This low-cost steel raceway for electrical wiring is threadless—thus eliminates one of the most toilsome, grimy jobs of installation—thread cutting.

Simple, compression-type couplings and box connectors make positive watertight joints. The only tools you need are a pair of pliers or a wrench, and a hacksaw for cutting the tubing.

Other compression-type fittings designed specifically for use with ELECTRUNITE STEELTUBES are made in a complete range of styles and sizes by several manufacturers. (See page opposite). And either the standard E.M.T. box connector or a special split adapter permit you to use this raceway with threaded fittings, if necessary.

ELECTRUNITE STEELTUBES has other features, too, which make electrical installation easier and prevent waste of material. The ELECTRUNITE Bender enables you to make *accurate, predetermined* bends with less effort. The knurled inside surface reduces drag in wire pulling. Light weight and uniform ductility save backaches and armaches.

Use ELECTRUNITE STEELTUBES for your next job—and see the difference it can make. It's approved by the National Electrical Code for exposed, concealed and *concrete slab* construction.

In the meantime, if you haven't received a copy of the booklet, "The Bending System for Republic 'Inch-Marked' ELECTRUNITE STEELTUBES," see your ELECTRUNITE Distributor or write us for a copy.

Buy From Your Local ELECTRUNITE Distributor

He's the exclusive ELECTRUNITE Distributor in your territory. He carries complete stocks of ELECTRUNITE STEELTUBES, accessories, fittings and a dependable line of electrical supplies—for your convenience. He can help you in many ways—from helping you to prepare estimates to keeping jobs moving on schedule. Get acquainted with him. He's a good man to know.

REPUBLIC STEEL CORPORATION

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Standardize on CONDULETS!

You can meet every need from a single source—the world's largest manufacturer of electrical conduit fittings.

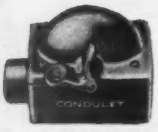
(CONDULETS are made only by CROUSE-HINDS)

A few of the many CONDULETS for non-hazardous locations

Type C Condulet with Tumbler Switch

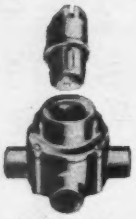
Type FS with Pilot Light, Tumbler Switch and Plug Receptacle

Type ALC Cushion Fixture Hanger

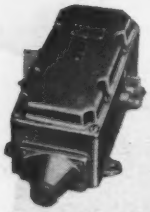


Type FS Condulet with Vaportight Cover

Type OSA Fixture Hanger



Type GST with Receptacle Equipment



Type YSW Vaportight Circuit Breaker Condulet

Type ARE Arktite Receptacle

Type WMK Raintight Safety Switch Condulet

Type APJ Arktite Plug

CONDULETS — the complete line — engineered to enable the electrician to do the job and do it right. There is a type for every purpose.

Arktite circuit-breaking plugs and receptacles.

Vaportight Condulets for use where exposed to weather, moisture, steam or non-combustible dust.

Dust-Tight Condulets for use where combustible dust creates hazardous conditions.

Explosion-Proof Condulets for use in locations that are hazardous because of the probability of the presence of flammable gases or vapors.

A Nationwide Distribution Through Electrical Wholesalers

Type VC Vaportight Lighting Fixture Condulet

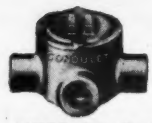
Type VDA Vaportight Lighting Fixture Condulet with Reflector

Type DLA Dust-Tight Lighting Fixture Condulet with Reflector

Type EVA Explosion-Proof Lighting Fixture Condulet

Type EVA Explosion-Proof Lighting Fixture Condulet with Shallow Bowl Reflector

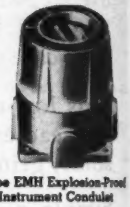
A few of the many CONDULETS for hazardous locations



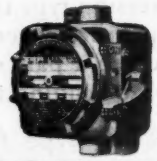
Type GUAT Explosion-Proof Junction Condulet

Type EFS Explosion-Proof Tumbler Switch Condulet

Type LBH Explosion-Proof Junction Condulet for Pulling Cables

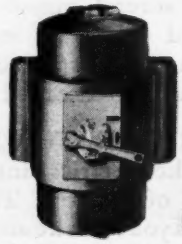


Type EMH Explosion-Proof Instrument Condulet



Type GUSC Explosion-Proof Line Starter Condulet

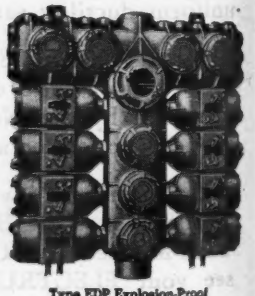
Type FSQC Explosion-Proof Interlocked Receptacle and Switch Condulet



Type EPC Explosion-Proof Circuit Breaker Condulet

Type GUB Explosion-Proof Junction Condulet Any Hub Arrangement

Type EYS Sealing Condulet



Type EDP Explosion-Proof Panelboard

CROUSE-HINDS COMPANY

SYRACUSE 1, N. Y., U.S.A.

Offices: Birmingham—Boston—Chicago—Cincinnati—Cleveland—Dallas—Denver—Detroit—Houston—Indianapolis—Kansas City—Los Angeles—Milwaukee—Minneapolis New York—Philadelphia—Pittsburgh—San Francisco—Seattle—St. Louis—Washington. *Resident Product Engineers:* Albany—Atlanta—Charlotte—New Orleans

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CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

THE NATIONAL DEBT—
and Your Postwar Job

Coming upon the heels of a ruinous ten-year depression, this war has once more made it clear to us that the strength of our country depends upon our ability and willingness to produce. Until the world conflict eclipsed the depression, we saw what failure to use our productive capacity can do — even to a country potentially as rich as ours.

The stark reality of war finally shocked us out of our economic lethargy. The necessity of supplying our Armed Forces with almost unlimited quantities of goods unleashed our inventive genius and revealed to us our real capacity to produce. It indicated what our standard of living might be if, in time of peace, we used our full productive capacity.

Today we are producing more than all the other nations combined, half again as much as in 1940. Today our production is insuring victory to our fighting men.

But what of the future?

Already our national debt has reached astronomical proportions, and it is going higher. The depression years' fear of insecurity that all but paralyzed our spirit of enterprise, our inventive genius, and our natural instinct for expansion, appears likely to return promptly if industrial activity again is curtailed for long because of unwise public policies.

This war is being fought to make men free. But our economy cannot be kept free through military conquest alone. There is another responsibility which we on the home front cannot avoid any more than we can build walls around our future. That is the problem created by our frightening public debt.

This is a two hundred billion dollar war. It affects the lives of every one of us. At the end of this war, the public debt of the United States will be at least ten times the twenty-five billion dollars that it was at the end of the first World War. It will be almost twice the present annual national income of the country. The interest charge alone will be about 4 per cent of the national income. If the burden were spread evenly, interest alone would take at least $80.00 of every worker's income per year, or approximately $1.60 out of each and every weekly pay check.

Some people fear that the heavy taxes required by the debt will keep the country poor by obstructing employment and limiting the output of goods.

Others believe that the size of the debt does not matter because we owe it to ourselves. They reason that if A is taxed $100 to pay $100 interest to B, A has $100 less to spend and B has $100 more, but both together have the same amount. They, therefore, hold that the demand for goods and the volume of employment remain unchanged.

Which view is correct?

Is our huge debt bound to be a crushing burden which limits employment and lowers the nation's standard of living, or will it simply redistribute income? May the public debt under certain conditions even be used to help increase employment and raise our living standards?

Most people, rich and poor alike, find it difficult to believe that the national debt "just doesn't matter". They know that the interest alone on this huge debt will be almost equal to the total amount of taxes ever raised before by the government for all purposes in any peacetime year. They find it difficult to follow the kind of reasoning that suggests increasing the already mammoth debt year by year in order to maintain full production and employment. They fail to see how this "debt raising" can go on indefinitely.

On the other hand, the records show that other nations have more than once successfully managed even greater debt burdens than will confront the United States after the present war. The interest on the British debt after the Napoleonic Wars was nearly 8 per cent of the national income, and after the first World War was over 7 per cent. But despite heavy taxes and some unfortunate mistakes in economic policy (such as restoring the prewar pound), per capita real income in Great Britain rose about 31 per cent between 1920 and 1929. In fact, it rose as rapidly as it did in the United States. The world depression was far less severe in Britain than it was in the United States; and, by 1936, when industrial production still was 6 per cent below 1929 in the United States, it was nearly 16 per cent above 1929 in Britain. Britain's heavy debt burden proved less of a handicap to her during the depression than our weak banking system did to us.

Whether the debt becomes a crushing burden or whether we use it to further our progress depends upon who holds the debt and how the money is raised to pay the interest.

Here are the important possibilities:

1. If the expenses of the government, including the interest on the debt, are met largely by heavy taxes upon business profits—i.e., by taxes upon job-giving—then they will reduce employment, output, and our standard of living, regardless of who holds the debt. Heavy taxes on profits prevent enterprise from expanding current operations or enlarging the capacity of its plants, unless the prospects for profit seem certain and the prospects for loss are slim. Hence the jobs that might be created by take advantage of long chances will not come into existence, and the country as a whole will be poorer.
2. If the expenses of the government are met largely by stiff surtaxes upon the incomes of persons who do a considerable amount of saving, and the debt is, in the main, owned by millions of small investors, then the net effect of the debt upon the volume of employment and output will be fairly neutral. The stiff surtaxes, while reducing the savings of the well-to-do, will cause them to avoid risky investments and to hold part of the savings of each year in the form of cash. This will limit the demand for goods and the volume of employment. But this effect will be partially offset if millions of small holders of the debt are led by their savings in government bonds to spend a larger part of their current income.
3. If the expenses of the government are met largely by sales taxes or other taxes on small incomes, and if the debt is held largely by the well-to-do or by business corporations, then the effect of the debt will be unfavorable to employment and production. The limitation to the spending power of the small-income group will reduce the volume of investment opportunities, and the transfer of income to the well-to-do will increase the volume of investment-seeking funds.
4. If the debt is widely distributed among millions of small holders, and the expenses of the government are met largely by taxes on individuals, if substantial exemptions from surtaxes are given for all income invested in new plant or equipment, and if there are liberal offsets for losses, then the debt will help increase employment and raise the standard of living. The millions of small holders will gain a sense of security from their accumulated savings and hence be encouraged to spend a larger portion of their current incomes. The stiff surtaxes will reduce the savings of the well-to-do; liberal exemptions for income put into new plant and equipment, and generous treatment of losses, will cause the well-to-do to invest their savings in job-giving enterprise rather than to hold them in idle cash.

But what is the situation today?

Today, non-banking corporations own nearly half of the Federal debt, commercial banks about one-fourth, and individuals less than one-fourth. Not more, and probably less, than one-tenth of the debt is held by persons earning less than $5,000—although these persons receive three-fourths of all income.

Today, about half of the revenues of the Federal government come largely from taxes which must be regarded as ***taxes upon the creation of new jobs.*** If these conditions continue, we may be sure that the debt will be a disastrous obstacle to a rising standard of living after the war.

What can be done to change this situation?

To begin with, vigorous steps should be taken to get much more of the debt into the hands of individuals, particularly of those in the small-income group. During the last three years, the incomes of individuals, after taxes, have exceeded the supply of consumer goods by $74.2 billion. In other words, individuals have been compelled, by the sheer scarcity of goods, to save over $74 billion. Of this amount, only $27.4 billion, or 37 cents out of every dollar, has gone into government bonds. Indeed, individuals have saved more in the form of cash and bank deposits than in the form of government bonds. The sale of war bonds to individuals was most disappointing in the recent drive. It was so disappointing, in fact, that I would favor a special drive ***for individuals only,*** to be scheduled before the next general drive. During 1944, when the supplies of civilian goods are severely restricted and when the fighting is at its climax, the Treasury will have its best opportunity to persuade individuals to buy more bonds. This opportunity should not be lost. An increase of at least twenty-five billion should be the goal for the next year. Every citizen should be made to understand that by buying war bonds now, he is not only helping to win the war; he is helping to make possible a more prosperous and stable America after the war.

The efforts to sell bonds to individuals should be vigorously continued throughout the shift from war production to civilian production. During this period, corporations which, up to now, have been the largest buyers of government bonds, will need all their depreciation allowances and undistributed profits to pay for new equipment, and to restore their own dealers' inventories. The government, however, will still have large bills to settle and will need to sell as many bonds as it can for some months after the end of hostilities. During this period, the demand for most types of goods is likely to exceed the immediate productive capacity of industry. Hence, the sale of bonds by the government will make for economic stability.

The huge expenses, including interest on the debt, which the government must meet after the war, require that the tax system be drastically reformed. Today, taxes fall most heavily upon those incomes which are the reward for increasing production and employment, because profits are taxed first as corporate profits, and taxed again as dividends to owners of the corporation. Surtaxes are so stiff and offsets for losses so meager that the well-to-do capitalists cannot afford to encourage and help promising young businessmen to start new enterprises.

A nation whose expenses are as large as those of the United States will be after the war must be sure that its tax system provides incentives, not penalties, for increasing production and employment.

Should the debt be repaid? Some people fear that any reduction of the debt would have a deflationary effect and cause unemployment. An opposite view was expressed by Mr. Morgenthau recently: "We have a big public debt that must be paid off, and the quicker we do that the better." Both of these views are extreme. Repayment of part of the debt during a period of depression would increase unemployment. Every period of high prosperity, however, would give the government an opportunity to pay off part of the debt without limiting employment. During these periods of prosperity, business corporations will sell government bonds in order to buy equipment; and many individuals will redeem war savings bonds in order to purchase houses, automobiles, and other goods. If the government budget runs a surplus during periods of high prosperity, and if this surplus is used to retire some of the bonds sold by corporations or redeemed by individuals, the country will be protected against a disorderly and speculative rise in prices. Thus, reduction of the debt can be made a device for stabilizing our economy.

There are two other reasons why reduction of the debt will be desirable.

In the first place, it will help prepare the country financially for a possible third World War. Determined as we are that this war shall be the last one, common sense tells us not to count on this. At any rate, we must be prepared for any eventuality.

In the second place, gradual reduction of the debt would stimulate employment by creating the expectation of lower taxes. It is not generally appreciated how much the willingness of individuals and business concerns to spend money is affected by the prospects of higher or lower taxes. One of the best ways to make individuals and enterprises spend more freely is to convince them that taxes will become a little lower, year by year.

Many people have difficulty in visualizing the day when there will be a substantial reduction in the burden of the national debt. And yet, if the country pursues wise economic policies, there is no reason why the debt burden should not be cut in half during the next generation.

The days of technological progress and economic expansion are not over. They are, in fact, only well begun. During the Twenties, the national income in dollars of constant purchasing power increased by well over 50 per cent. Between 1929 and 1939, it increased by less than 6 per cent. Perhaps the rate of the Twenties cannot be maintained indefinitely; but scientific research and development work in industry are laying the foundation for very large advances in national income. Suppose that the national income increases 33 per cent in the first decade after fighting stops (say, hopefully, 1945), 25 per cent in the next decade, and thereafter at the rate of 20 per cent a decade. In 1955, the national income (at present prices) would be about $173 billion; in 1965, about $216 billion; and in 1975, about $257 billion. By 1970, the burden of the debt would be reduced by nearly half, even if not a cent of it were repaid!

A huge public debt is a test of the character, the common sense, the foresight, and the equally important technical and engineering skill of a nation. ***It requires that tens of millions of small income earners be willing to become substantial holders of the debt. It requires that the nation be willing to tax itself heavily, but in ways which increase the attractiveness of job-giving or self-employment relative to job-holding; it requires that the nation be willing to pursue policies of expansion and to put a rising income for the nation ahead of the pleas of self-seeking groups in labor, agriculture, and industry.***

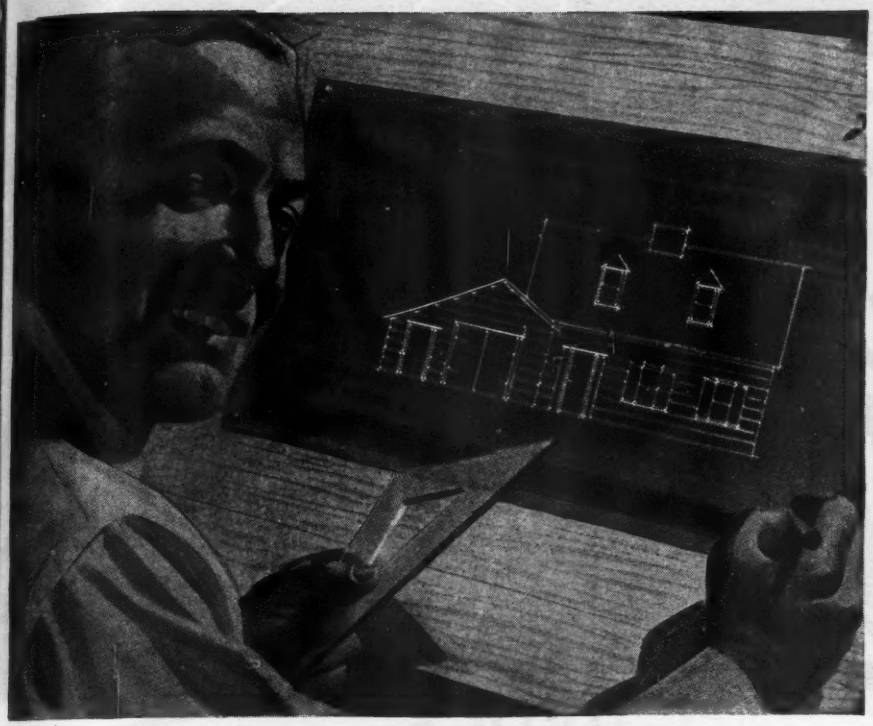
A huge debt may so draw out the hidden powers of a people that it makes the nation wealthier rather than poorer, stronger rather than weaker.

Up to now, Americans have not met the test of a big public debt too well. Individuals have saved more in cash than in government bonds, and the country has shown little interest in avoiding the kind of taxes that reduce the demand for labor. These shortcomings, I am sure, stem largely from the fact that the American people never have had the problems of debt and taxation honestly and adequately explained to them.

I have confidence in the American people. I believe that Americans have the intelligence to understand this problem of the public debt, the character to face their responsibility regarding it, and the common sense to accept the challenge and make the most of it.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.



Blueprint for a dream

IT ISN'T WRONG to daydream a little bit . . . to lean back for a moment and picture your life as you hope it will be. For, out of the dreams of a war-torn world will come the practical plans for a welcome peace.

The bonds you are patriotically buying now—these are the practical means that will lead to the fulfillment of some of those dreams—the house you've always cherished...warm, friendly, gracious, for all the years to come. But it will take more than dreams and more than money to make it a reality.

It will take the vision and intelligence of an architect to turn that glowing daydream into a sensible home. His training and experience help you to avoid the heartbreak of a misbuilt house. His counsel is your best guarantee for lasting beauty of design, fair resale value, low maintenance cost.

• • •

Imagine building a school or a skyscraper without an Architect-Engineer! The same expert help will make your house attractive and livable. Why not protect your investment with an architect.

Plan your house now!

START RIGHT—

WITH AN

ARCHITECT.

EDWARDS

SINCE 1872

ELECTRICAL SIGNALING

Bells · Chimes · Telephones · Alarms

for Homes, Offices, Schools, Hospitals

FREE . . . GET THIS NEW ILLUSTRATED BOOK!

T221

EDWARDS AND COMPANY, NORWALK, CONN.

Please send copy of book "How to Plan Your New Home."

Name_____

Street_____

City_____ State_____

(Save Postage—Paste Coupon on Penny Post Card)

More BUSINESS for the Architect —and YOU!

• More business for the architect means more business for electrical wholesalers and contractors. That's why you'll be interested in keeping abreast of Edwards' campaign to sell the architect's services to people who plan to build as soon as the war is over. That's why we reproduce the advertisement at the left—the fourth of a series now running in "Time" and "American Home."

• The terrific response to this campaign (over 28,000 requests to date!) is an indication of the part the architect will play in building postwar America, and just as strong an indication that more and better wiring and equipment will be used.

• A copy of the booklet that has created such a stir among the building public is yours for the asking—just use the coupon at the left.

AN OK TO PORCELAIN PROTECTED WIRING *Systems...*

OVER 50 YEARS AGO *and* DURING ALL THE YEARS

WHEN porcelain was first used for wiring more than half a century back, its many advantages were quickly recognized . . . and the O. K. that was to live on during all these years was given.

Certainly with the contribution porcelain has made to modern, adequate, permanent, and low cost wiring, there is every reason why it continues to be so extensively used.

Check the many benefits of Porcelain Protected Wiring Systems and you'll see why it is the immediate and positive answer to installations you have pending or that you will contract for in the future.

- Complete Insulation
- Full Protection
- Short Proof
- Shock Proof
- Rust and Corrosion Resistant
- Permanent
- Adequate
- Economical
- Maximum Current Capacity Ratings
- Takes Standard Devices and Fixtures
- Makes Installations Easier
- Meets Future Load Increase
- Allows for easily made Alterations and Additions
- Conserves Vital Materials

★ **ILLINOIS ELECTRIC PORCELAIN CO.** *Macomb, Ill.*

★ **PORCELAIN PRODUCTS, INCORPORATED** *Findlay, Ohio*

★ **SPECIALTY PORCELAIN WORKS** *East Liverpool, Ohio*

★ **SUPERIOR PORCELAIN COMPANY** *Parkersburg, W. Va.*

★ **UNIVERSAL CLAY PRODUCTS COMPANY** *Sandusky, Ohio*

MODERN PORCELAIN PROTECTED WIRING SYSTEMS

KEEP PACE WITH PROGRESS

The Howell Protected Type Motor, shown, gives complete protection against dripping liquids, metal chips and other falling particles. Completely streamlined—utilizing non-breakable steel frame—malleable or steel base—cast iron end plates and cast iron, weatherproof terminal box are standard construction features. Special horizontal and vertical mountings are available.

ELECTRICIAN: What are *you* doing here?

HORSE: I'm going to give you a tip—going to steer you straight to the best buy in electric motors.

ELECTRICIAN: We've been buying motors from the same firm for 17 years—we know motors.

HORSE: That's just it. A lot of improvements have been made since you first investigated motors. Take Howells, for example. All our motors are precision-built—many of them are specially built for the job they are to do. Today, we're building specialized motors for machine tools, ventilating fans, air conditioning equipment, dairy work, almost every job you can name. And Howell Motors are doing these jobs at lower costs and with less trouble.

ELECTRICIAN: You mean you will furnish specialized motors for my job? Why, I thought I had to take standard motors! I guess I better keep pace with progress.

Get acquainted with Howell Motors now. Phone the nearest Howell representative or write direct to the factory.

HOWELL ELECTRIC MOTORS COMPANY
HOWELL, MICHIGAN
Manufacturers of Quality Motors Since 1915

1000 B.C.

Illustration taken from Continental's instruction manual shows proper method of sanding this multi-bar commutator.

1000 Volts **B**etween **C**oils is the operating voltage of these engine driven generators being built for the Signal Corps by *Continental Electric Co., Inc.* of Newark, N. J.

They are tested at 3000 volts—three times their normal voltage. Yet compact design allows only minimum clearance between coils!

Natvar varnished acetate and Natvar varnished silk were chosen by *Continental* for this important application because they are *thin*, because they have *high dielectric strength*, and because they are *uniform*.

What are *your* insulation problems? Write, wire or phone us for deliveries, either from stocks located near you, or from our own.

Natvar

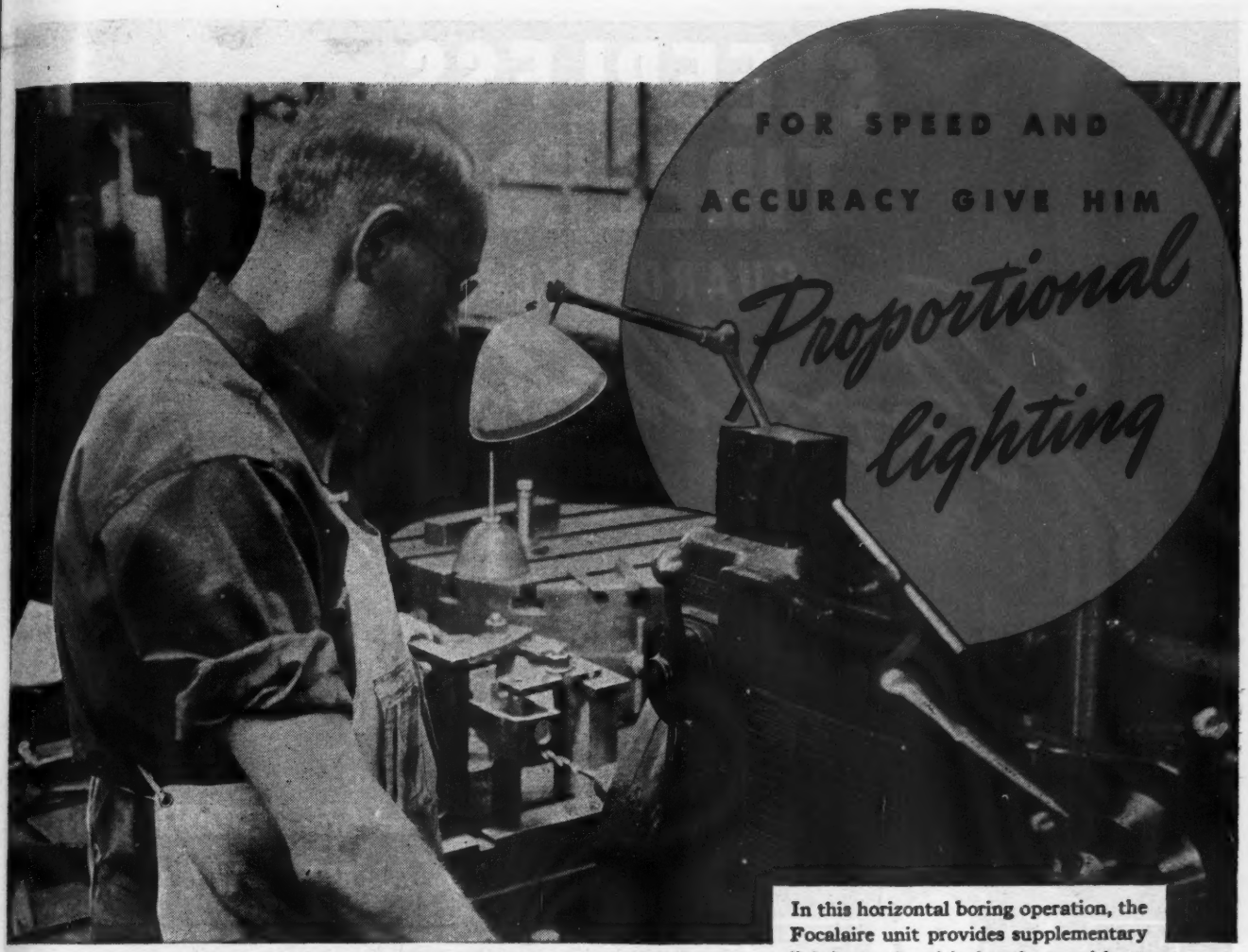
- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished cellulose acetate
- Varnished Fiberglas cloth
- Varnished papers
- Varnished tubings and sleevings
- Varnished identification markers
- Lacquered tubings and sleevings
- Extruded Vinylite tubings
- Extruded Vinylite identification markers

THE NATIONAL VARNISHED PRODUCTS Corporation

TELEPHONE
RAHWAY 7-2171

CABLE ADDRESS
NATVAR: RAHWAY, N. J.

205 RANDOLPH AVENUE ★ WOODBRIDGE NEW JERSEY



In this horizontal boring operation, the Focalaire unit provides supplementary lighting on the critical work area without throwing glare in the operator's eyes.

Proportional lighting is the right combination of general and supplementary lighting necessary for quick, accurate vision at critical work areas. For supplementary lighting, Westinghouse offers a complete new line of Focalaire units for easy, quick installation on machines, assembly benches and worktables. Correctly installed, Westinghouse Focalaires—

Save Eyes . . . Stop Squinting . . . because each worker sees quickly and easily the things he must to do his job well and in comfort.

Improve and Increase Production . . . because workers adhere more closely to "specs" . . . and perform their job with confidence and precision.

Cut Production Costs . . . because proper lighting reduces rejects, cuts inspection time, increases production and prevents accidents.

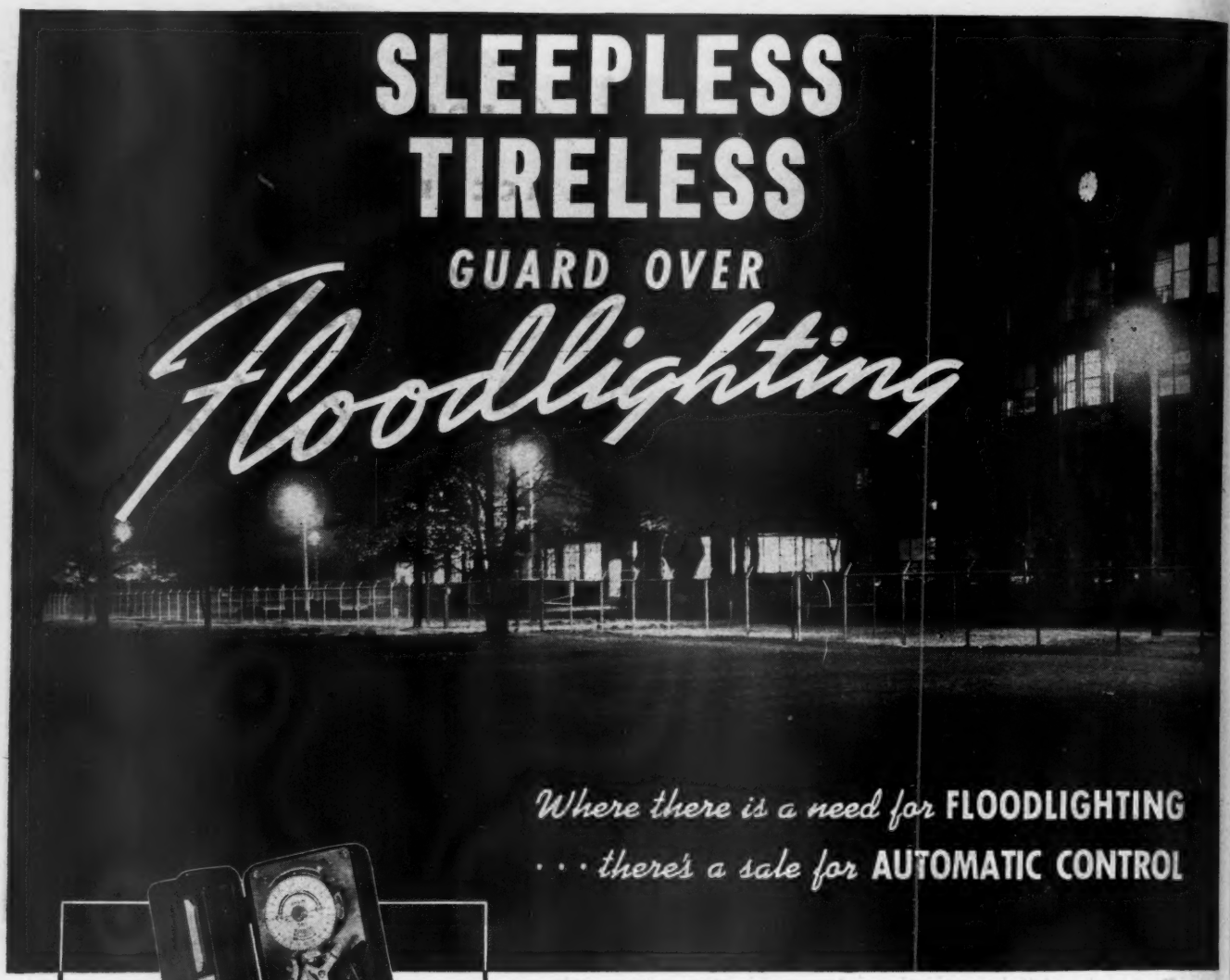
Six standard Focalaire units are now available from your Westinghouse Lighting Distributor. Or, for more information, write for B-3310. Westinghouse Electric & Mfg. Co., Dept. 7-N, East Pittsburgh, Pa. J-04003

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Lighting Equipment

SLEEPLESS TIRELESS GUARD OVER *Floodlighting*



Where there is a need for **FLOODLIGHTING**
. . . there's a sale for **AUTOMATIC CONTROL**

SANGAMO TIME SWITCHES

• There are types to meet every protective lighting control need. The complete line includes Astronomic Dial, Synchronous Carry-Over, and Outdoor Time Switches. Form VSW2 Astronomic Dial Time Switch is shown above. Current interruptions up to 10 hours will not stop it nor affect its "on" and "off" settings.

ARMY (E) NAVY

"ASLEEP ON THE JOB" and overtiredness happen where the human element is concerned. But not so with SANGAMO TIME SWITCHES. Never sleepy . . . never tired . . . always on guard, giving users full protection, so that the "on" and "off" times of floodlighting are exactly as scheduled.

It all means that there is an added sale for you whenever you sell floodlighting. You'll find that the idea of safeguarding with SANGAMO TIME SWITCHES is well received by those who order floodlighting installations.

Add to your new SANGAMO TIME SWITCH prospects the sales that can be made to present users of floodlighting who do not have automatic control and are subject to the serious consequences of forgetfulness, error, and neglect.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

Walker of Conshohocken is geared to deliver the fast prompt service so necessary in meeting wartime shipbuilding needs. A Walker promise of delivery is a promise you can rely on.

Walker Shipboard Cables are available either leaded or non-leaded; with Synthetic or Varnished Cambric Insulation. Made in accordance with Specifications AIEE-45A and U.S.M.C. — Design Memo #46.

WIRE WITH WALKER

walker of Conshohocken

Other

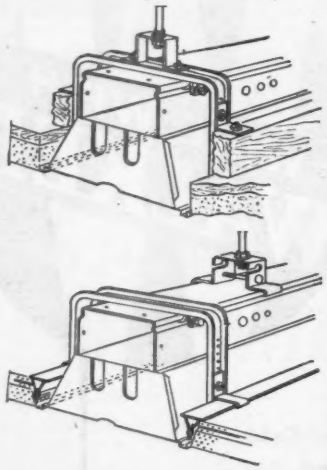
QUALITY PRODUCTS BY WALKER of CONSHOHOCKEN

- Rubber-Covered, Synthetic and Leaded Wires and Cables
- "Walkerflex" Non-metallic Sheathed Cables
- Service Entrance Cables
- Automotive Wires and Cables
- Electric Metallic Tubing
- "Dualcote" Rigid Steel Conduit
- "Preset-Inserts" Underfloor Distribution Systems

Ask your local Distributor for prices and deliveries that you can rely upon. WALKER BROTHERS, Conshohocken, Pa.

... for the man who likes it straight from the shoulder!

THE MILLER TROFFER SIMPLIFIES FURRING



Miller Troffers can be hung directly from *structural* ceiling and, by means of patented Miller bracket, the *false* ceiling (either wood or metal frame) can be hung from Troffer. This greatly simplifies furring and adds to flexibility of installation.

We have just rounded out 100 years in the lighting business but we don't think about it that way. *We* figure we're just starting our *second* 100 years—with feet firmly braced on past experience and eyes on the future.

We believe — implicitly — that we have developed the best dawgonne continuous flourescent lighting systems the world has ever seen —seen BY—and seen BETTER by.

They have proved themselves, breaking lighting bottlenecks on our production front. By consistently delivering the goods, they have *earned* their place of foremost consideration in postwar planning of all kinds, including offices, stores and schools.

The Miller two-light Troffer, shown above* can be economically installed (recessed, flush or pendant) in almost any type ceiling. It is attractive—and practicable—in single units, combinations of units or continuous rows BY THE MILE. Its shallow dished panels offer a wide variety of designs. It is so versatile that its applications are almost as unlimited as the architect's ingenuity.

It is economical to service and so economical to operate that building-wide installations are often decided upon—instead of replacement of an occasional fixture.

As the huge wartime bulge in industrial lighting tapers off, new users of fluorescent lighting will fill the gap. Fill it for the contractor who is modern in every sense.

Our engineers are in principal cities and they are there to help you lick lighting problems. So call a Miller Engineer—or call us directly — and see what 100 well-spent years have taught us.

**Shown now only for your advance planning.*

THE MILLER COMPANY • MERIDEN, CONNECTICUT

ILLUMINATING DIVISION
Fluorescent, Incandescent
Mercury Lighting Equipment

OIL GOODS DIVISION
Domestic Oil Burners
and Liquid Fuel Devices

ROLLING MILL DIVISION
Phosphor Bronze and Brass
in Sheets, Strips and Rolls

WAR CONTRACTS DIVISION
War Materiel

MILLER
SINCE 1844

THE HOME OF THESE*

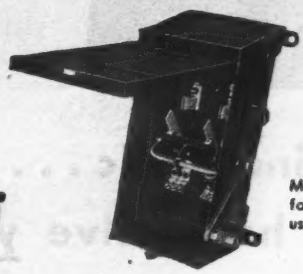
Federal

NOARK ELECTRIC PRODUCTS

Newark, New Jersey Plant

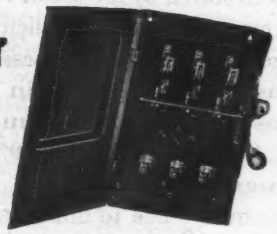
MAKING HISTORY *Today*

ON THE FIGHTING FRONT



Maritime Switch for Shipboard use

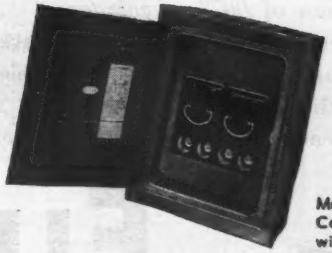
ON THE INDUSTRIAL FRONT



600 Volt Rotare Type Knife Blade Switch

Tomorrow

ON THE HOME FRONT



Main and Range Combination with 4 lighting circuits

FEDERAL ELECTRIC PRODUCTS COMPANY

PLANTS AT: 1429 PARK STREET, HARTFORD, CONNECTICUT AND 50 PARIS STREET, NEWARK, NEW JERSEY

FIBERGLAS* Electrical Tapes...

. . . inorganic . . . strong . . . wide range of sizes . . . can help solve <u>your</u> electrical insulating problems

Many complicated electrical design and repair problems have been solved by the use of Fiberglas Tapes. One of the many advantages is their availability in a wide range of widths and thicknesses.

Fiberglas Tapes are as thin as .003" and as thick as .015", with intermediate thicknesses of .005", .007" and .010"... Standard widths range from ⅜" to 1½".

But, you can also add to this feature the extraordinary tensile strength of Fiberglas Tape! Fiberglas Tape—½" x *.003"*—has an approximate breaking strength of 80 lbs.! Compare this breaking strength with those of *.007" organic tapes!*

Fiberglas Tapes, being glass, have many properties which make them most desirable for use in the insulating of electrical equipment . . . resistance to high temperatures, moisture, oil, corrosive vapors. In combination with suitable varnishes, the result is longer-lasting and more efficient electrical insulation.

Fiberglas is available in all of the standard untreated forms, together with varnished cloth, mica-Fiberglas combinations, varnished sleeving, pressure-sensitive tapes and Fiberglas laminates.

So, whether you manufacture, service, buy or use electrical equipment—Fiberglas is worth knowing about, in every detail.

Fiberglas electrical insulating materials are now IMMEDIATELY AVAILABLE in quantity from distributors' stocks.

When you write for complete information, include a request for your copy of booklet "What Keeps the Wheels Turning" . . . *Owens-Corning Fiberglas Corporation, 1856 Nicholas Bldg., Toledo 1, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.*

ARMY E NAVY

FIBERGLAS ...A BASIC MATERIAL

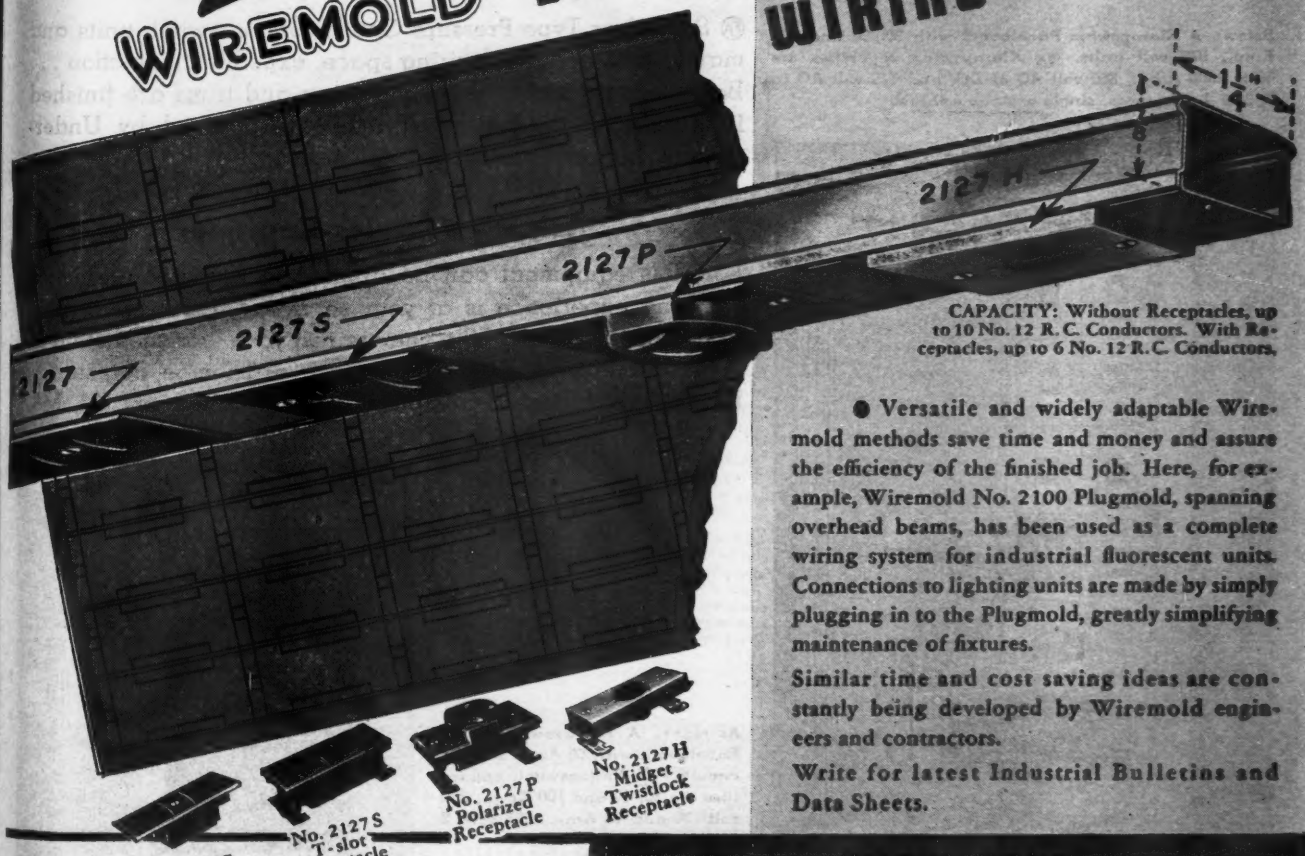
*T. M. Reg. U. S. Pat. Off.

YARNS • TAPES • CORD • SLEEVING • CLOTH AND OTHER FORMS

the problem

the answer

WIREMOLD SIMPLIFIED, FUNCTIONAL WIRING METHODS



CAPACITY: Without Receptacles, up to 10 No. 12 R. C. Conductors. With Receptacles, up to 6 No. 12 R. C. Conductors.

● Versatile and widely adaptable Wiremold methods save time and money and assure the efficiency of the finished job. Here, for example, Wiremold No. 2100 Plugmold, spanning overhead beams, has been used as a complete wiring system for industrial fluorescent units. Connections to lighting units are made by simply plugging in to the Plugmold, greatly simplifying maintenance of fixtures.

Similar time and cost saving ideas are constantly being developed by Wiremold engineers and contractors.

Write for latest Industrial Bulletins and Data Sheets.

No. 2127 Plug Receptacle
No. 2127 S T-slot Receptacle
No. 2127 P Polarized Receptacle
No. 2127 H Midget Twistlock Receptacle

WIREMOLD CAN HELP YOU PRODUCE FOR WAR . . . WHILE YOU PLAN FOR PEACE!

KNOW YOUR

WIREMOLD

AND YOU KNOW THE ANSWERS

THE WIREMOLD COMPANY, HARTFORD 10, CONN.

Prevent Shock!

Accidental contact with live parts is impossible with tnese

PANELBOARDS

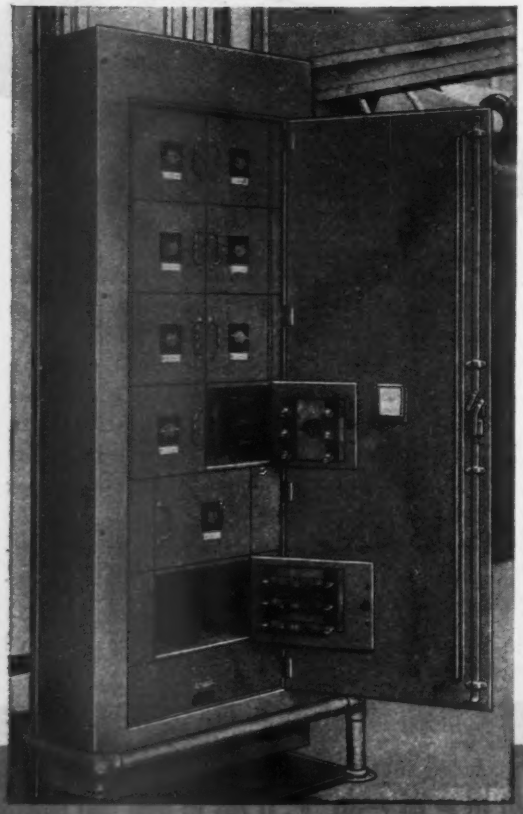
***for* LIGHT *and* POWER**
FEEDER DISTRIBUTION

In these panelboards, *the switch and fuse are combined in one unit* — the current is OFF when the door is open, or the fuse carrier removed. This arrangement also renders replacement of fuses safe — quick — and easy.

Both the (FA) Klampswitchfuz and the (FA) Pulfuzswitch Panelboards are assembled from standardized units. In each, the switch blades make *pressure contact* with the fixed switch parts, assuring full current-carrying capacity. This, with the silver-plated contact parts, insures low resistance to current flow, and reduces heating.

(FA) Solderless Type Pressure Connectors on switch units and mains, and generous wiring space, expedite connection . . . Boxes are treated to prevent rusting and trims are finished in attractive pearl gray enamel . . . Approved by Underwriters' Laboratories, Inc.

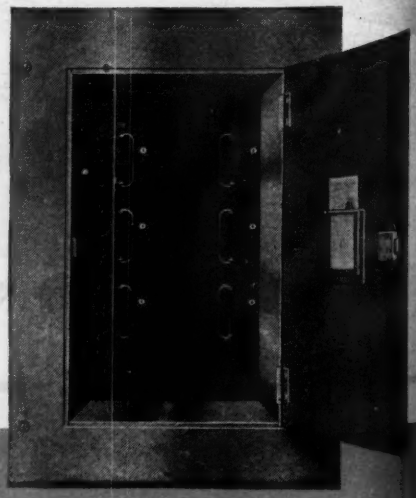
Below: A Klampswfuz Panelboard with 30, 60 and 100 Amp., 575 volt units. (FA) Klampswfuz capacities are 30 to 1200 Amp., 250 volt AC or DC, and 575 volt AC in 2, 3 or 4 pole types, single or double throw.



Ask the (FA) Sales-Engineer

how this equipment can be applied to your requirements. His long experience is at your service, without obligation. Write for the name of the one nearest you — or see listing in Sweet's, Electrical Buyers' Reference, or Thomas' Register . . . Frank Adam Electric Company, Box 357, St. Louis (3), Mo.

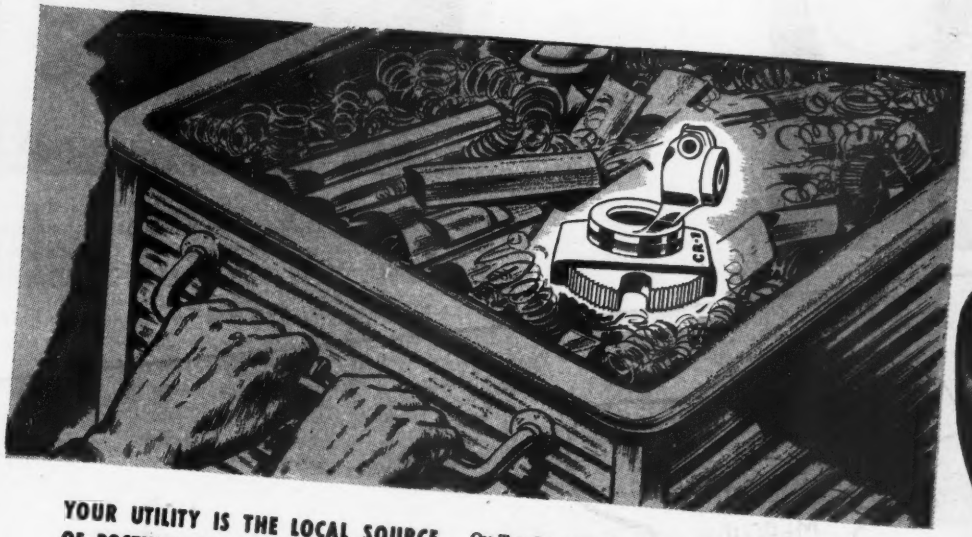
At right: A Pulfuzswitch type Panelboard with 60 Amp. branch circuits. (FA) Pulfuzswitch capacities are 30, 60 and 100 Amp., 250 volt; 30 and 60 Amp., 575 volt, 2 and 3 pole.



Frank Adam
ELECTRIC COMPANY
ST. LOUIS

Why CR-1 *Missed the Fight...*

CR-1 was a fighter plane part . . . made on the swing shift and gauged perfect within .0001ths of an inch. Its component part CR-2 was finished and gauged in the heat of next day. But by that time, CR-1 had expanded beyond tolerance—preventing an accurate fit. So CR-1 became scrap . . . instead of getting in the scrap! THE MORAL: Controlled temperature can improve all manner of processes and materials . . . metals, foods, chemicals, fibres . . . help to hold dimensions, characteristics and quality within close limits. So, if your operations are weather-sensitive—(and most are!) . . . you'll want to check up on air conditioning—for production—tomorrow!



YOUR UTILITY IS THE LOCAL SOURCE OF POSTWAR AIR CONDITIONING FACTS

ON THE PAYROLL of your local utility is a skilled engineer who can help you determine *where* and *how* to air condition from the twin viewpoints of top product quality and low production cost.

Sure, his company has something to sell. But his "know-how" and cooperation are yours for the asking . . . can help you save time and take advantage of the experience of others.

And when it comes to modernization, look to Roebling for all the specialized wires and cables you'll need . . . for better air conditioning, lighting, power distribution and other electrical and electronic cost-cutters the war has produced.

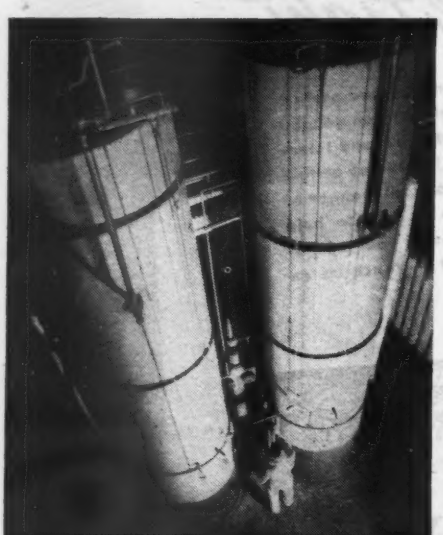
JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

ROEBLING
PACEMAKER IN WIRE PRODUCTS

Wire Rope and Strand • Fittings • Cold Rolled Strip • Aircord, Swaged Terminals and Assemblies • Round and Shaped Wire Wire Cloth and Netting • High and Low Carbon Acid and Basic Open Hearth Steels Suspension Bridges and Cables • Electrical Wires and Cables • Aerial Wire Rope Systems

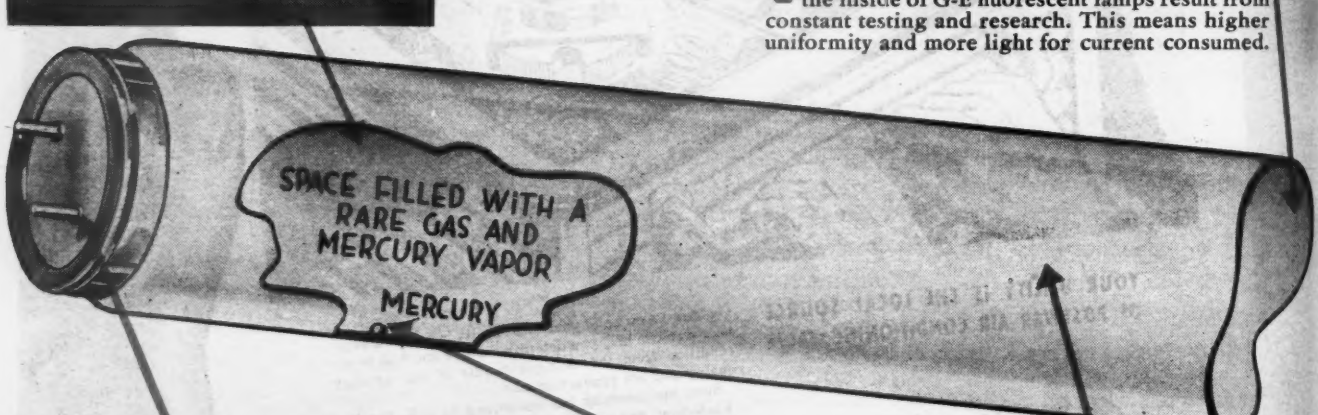
STIMULATING INTEREST in postwar electrical modernization, this Roebling advertising in "Mill & Factory" and "Purchasing" reaches 40,000 industrial executives with messages that will help to build business for you.

Here's the INSIDE STORY of a



1 304° below zero sounds pretty cold. Freezing argon gas at this temperature means drier, purer gas making starting easier, more uniform.

2 Improved phosphor powders used in coating the inside of G-E fluorescent lamps result from constant testing and research. This means higher uniformity and more light for current consumed.



5 The "Twist Test" checks G-E lamp ruggedness to withstand twists, strains, bumps. This test applies pressure to the base, pins and tubes.

6 A tiny drop of mercury is accurately measured and injected by automatic machines to give G-E lamps better, lower-cost performance.

7 More than 480 tests and inspections guard the high quality of G-E Fluorescent lamps. Here G-E lamps are checked during the "seasoning" process.

Hear the General Electric radio programs: "The G-E All-Girl Orchestra," Sunday 10 p.m., EWT, NBC; "The World Today" news, every weekday, 6:45 p.m., EWT, CBS.

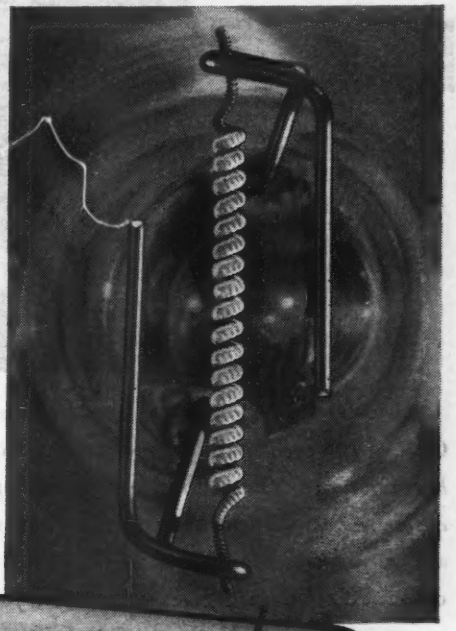
GENERAL ELECTRIC

# of a G-E FLUORESCENT LAMP

Chances are that you'll never examine what's inside a fluorescent lamp. But G-E engineers have done it—hundreds of thousands of times—in a constant, never-ending search for better and better lamp performance. Here are a few facts they've found out, while seeking more efficient, better lighting quality for fluorescent lamp users.

3 This instrument, the world's largest spectroscope, sets exact color standards for G-E lamps and provides assurance of correct color quality.

4 This coated cathode—here magnified many times—shows the sound, rugged construction which is built into every part of G-E fluorescent lamps.



8 This is a bare handful of inside facts about G-E fluorescent lamps—the better lamps that give more and more light at lower cost than ever before. For all the FACTS write for this FREE booklet, Y-432. General Electric, Dept. EC-H, Nela Park. Cleveland 12, Ohio.

"TO MAKE G-E LAMPS STAY BRIGHTER LONGER"

The Constant Aim of G-E LAMP RESEARCH

BUY AN EXTRA WAR BOND NOW!

G-E MAZDA LAMPS

BEARINGS

Double-row width for greater lubricant supply . . . less maintenance. Complete seal, both sides . . . keeps grease in . . . dirt out.

Uni-Shell MOTORS STAY ON THE JOB for 3 Big Reasons!

One of the two main reasons for motor deterioration is *bearing wear.* The second is two-fold: *poor insulation* and *excessive heat.* Both these primary causes of motor failure are conditions which R & M Uni-Shell Motors have been designed to eliminate. With them, you get day-in, day-out, trouble-free operating reliability.

Added to this, you take advantage of the mounting flexibility provided by Uni-Shell interchangeability. Shell length, diameter, base mounting holes, shaft dimensions, height of shaft above base, head fit, and bolt circle mounting for heads are exactly the same for any one frame size.

Taken together, these are the reasons why Uni-Shell Motors are doing an increasingly bigger job of supplying power for industry's needs. Learn how you too can profit by their use. Get all the facts by asking for your free copy of the new, helpful, 20-page Uni-Shell Motor booklet, today.

VENTILATION

Individually designed fan for each motor type produces maximum air flow for low-temperature, longer-life operation. A cool motor costs less.

INSULATION

Two layers highest-grade impregnated paper. Added sheet between coils in slot. Moisture-resistant resin and tung-oil sealer protects winding.

SHIPMENT NOW!

Ample stock on most types of integral motors on hand as this goes to press. Wire or phone your inquiry.

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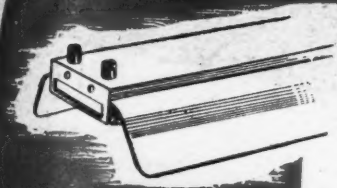
TRADE MARK

The Original Starterless Fluorescent has proved itself in gruelling tests since July 1942!

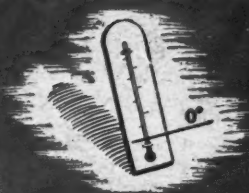


No Starter Switches

Maintenance cost is lower, and the problem of checking for "dead" Starters is eliminated.

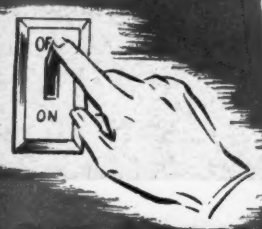
The GUTH QUICK-LITER was first introduced for use in War Plants; where high maintenance costs due to Starter-Switch troubles, and variable line-voltage conditions, made *Starterless* Fluorescent desirable. Detailed performance records were constantly maintained on the tens of thousands in use, with the result that every claim for QUICK-LITER has been *proved* by use.

A valuable report on the results of these tests is now available. Write for your copy today.



Would Operate in an Ice Box

GUTH Quick-Liters start and operate at as low as 0° F. 3,000 Quick-Liters are in daily use in Alaskan and Aleutian Island bases.



Lights Instantly

At the flick of the switch — there's light! No flickering, flashing, or waiting.

Immediately Available

GUTH Quick-Liters can be shipped at once on AA-5, or AA-2-MRO, or higher priorities.

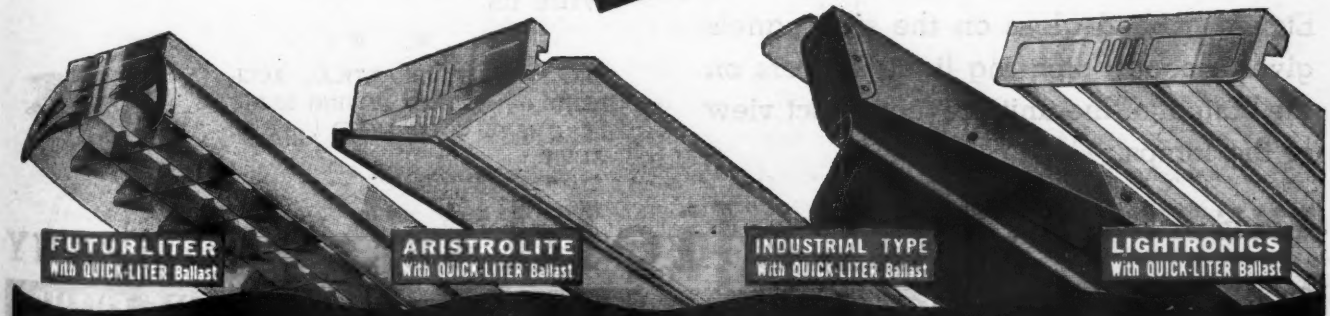
Long Lamp Life

Quick-Liter gets maximum usage from standard or special lamps. In many cases, lamps burned out on Conventional Ballasts and Starters operate on Quick-Liter.

Operates at Irregular or Low Voltage

Heavy electrical loads in many plants cause low or irregular voltage. Quick-Liter *starts* and operates at as low as 85 Volts.

Leaders in Lighting **Guth** *Since 1902*



THE EDWIN F. GUTH CO. • 2615 Washington Ave. • St. Louis 3, Mo.

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DESIGNED for high quality fluorescent lighting at lower cost, the BEACON is a "honey" for lighting essential offices or drafting rooms. Provides smooth, shadowless light to help handle paper work faster and reduce eyestrain.

Maintenance is especially easy since there are no horizontal surfaces on which dust can collect. Hinged louvers make lamp replacement easy.

Etched, ribbed glass on the side panels gives smooth, pleasing light; louvers on the bottom of the unit prevent direct view of the lamps.

Ballasts are only partially enclosed—which means cooler, better operation.

The new BEACON is of all-steel construction. Metal end caps are pierced in a decorative design and are backed up with diffusing, translucent plastic. And you can offer this 4-lamp fluorescent unit in stem suspension as pictured, or with close-up mounting for low-ceiling areas. Get the details NOW from Graybar or write us.

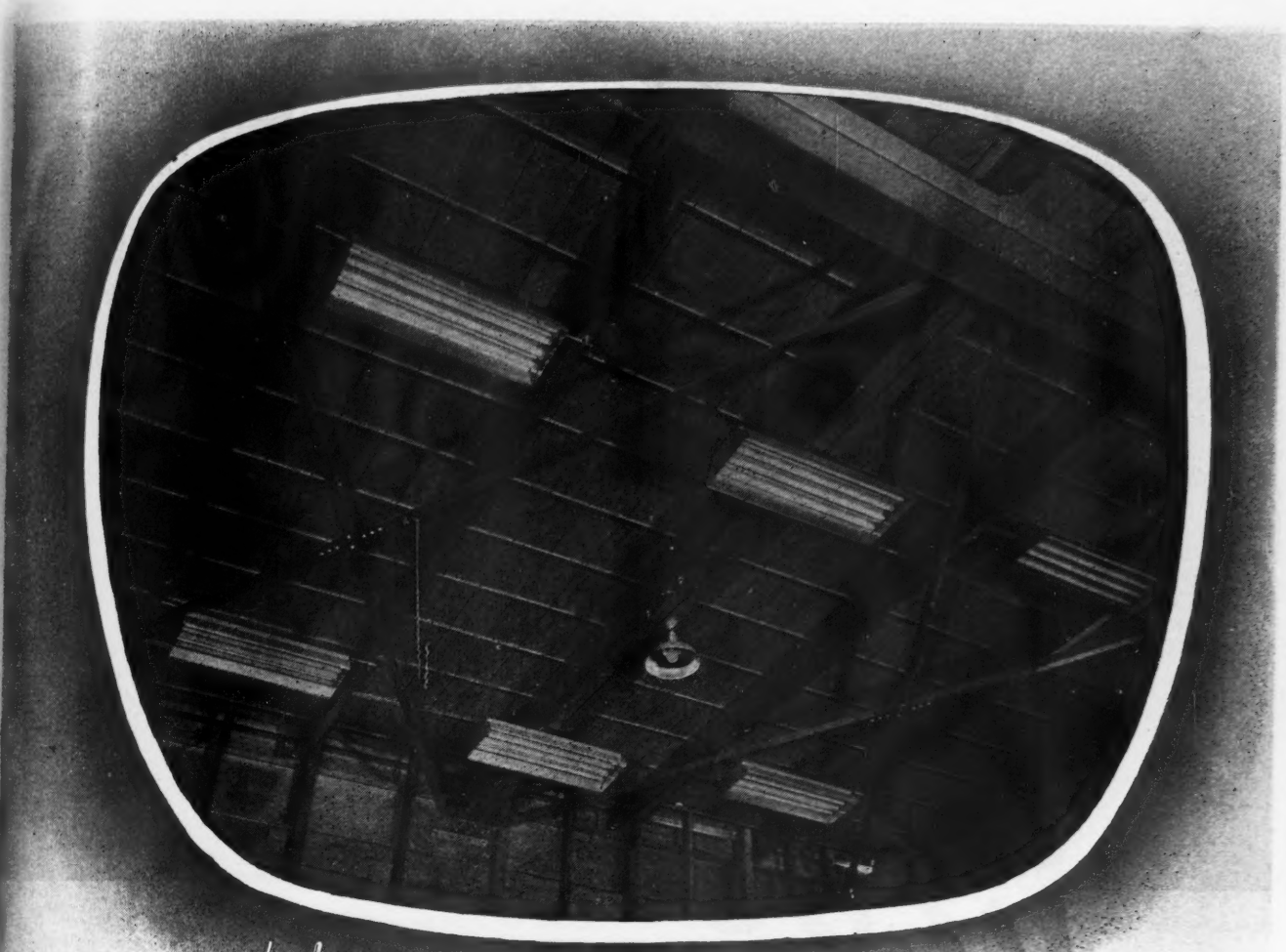
★ ★ ★

HELP PREVENT INDUSTRIAL ACCIDENTS . . . GUARD MOVING PARTS . . . HAVE GOOD LIGHT . . . BE ALERT.

THE F. W. Wakefield BRASS COMPANY

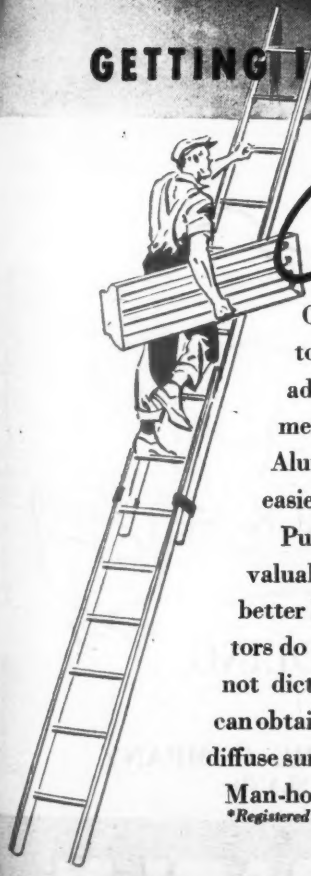
RED SPOT LIGHTING FOR WAR PRODUCTION . . . FOR PEACETIME FUTURE

VERMILION, OHIO



GETTING IT THERE IS EASIER WITH

Alzak* Aluminum Reflectors



On the question of manpower, manpower to install the lighting fixtures in a new addition or to relocate them as requirements change—the lighter weight of Alzak Aluminum Reflectors makes those jobs easier. It saves on man-hours to do the job.

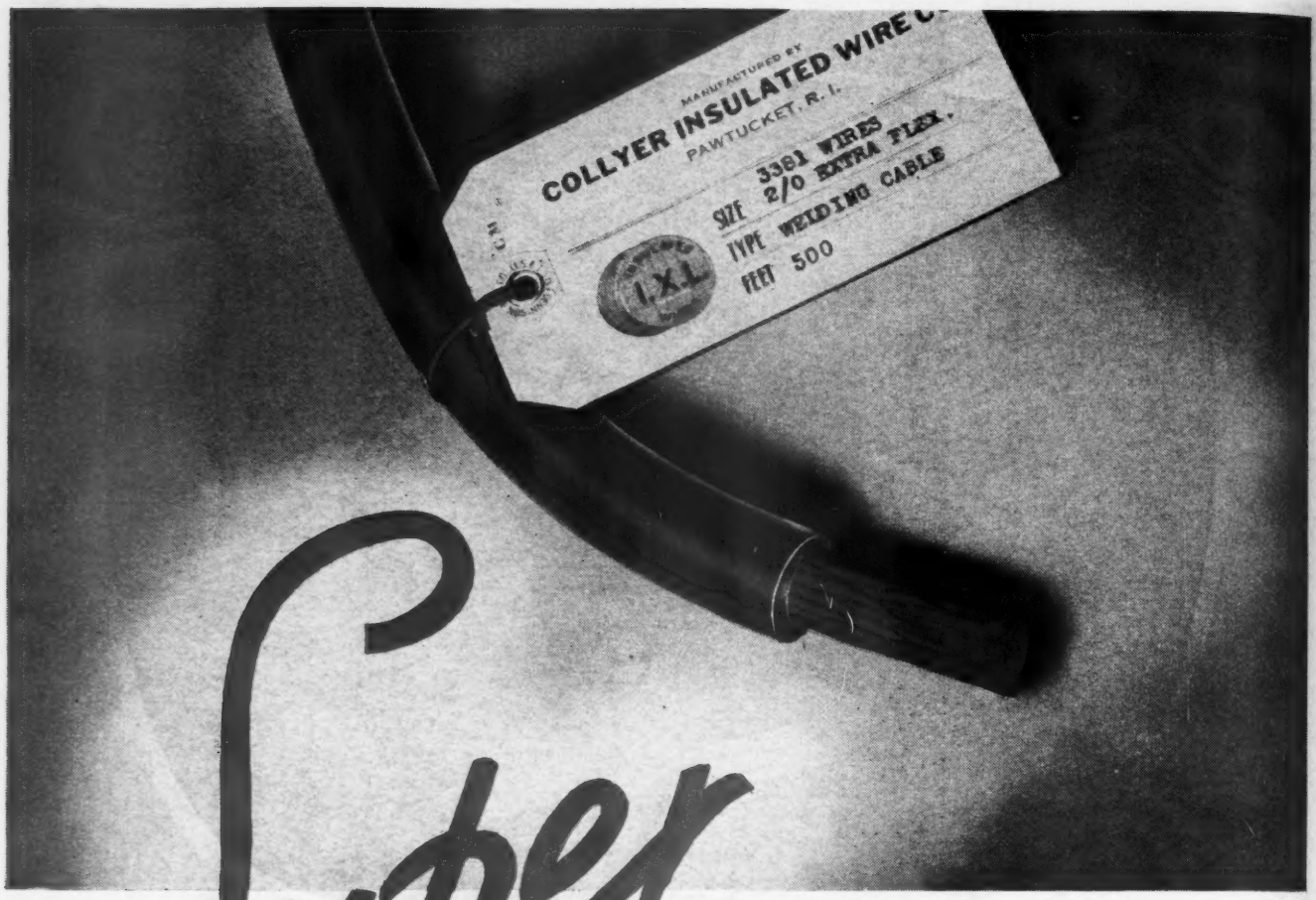
Putting light where you want it, gaining valuable man-hours on production through better lighting, is a job which Alzak Reflectors do especially well. Reflector shapes are not dictated by material limitations. You can obtain bright, specular finishes or matte, diffuse surfaces, or combinations of the two.

Man-hours are again saved by the ease with which Alzak Aluminum Reflectors can be cleaned. Dusting or washing with mild soap and water often suffices to keep them working at high efficiencies. Other methods may be needed under more severe conditions. But the glass-like hardness of the Alumilite finish (process patented) makes cleaning easy.

Some restrictions on using aluminum have been relaxed by the War Production Board, with special consideration where its use means substantial savings in man-hours. ALUMINUM COMPANY OF AMERICA, 1946 Gulf Building, Pittsburgh 19, Penna.

*Registered trademark

ALCOA ALUMINUM



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WELDING CABLE

FLEXIBLE AS A SERPENT

TOUGH-HIDED AS A RHINO

SHEDS DIRT & GREASE LIKE A DUCK'S BACK

NON-KINKING FOR SAFETY & EASY HANDLING

COLLYER INSULATED WIRE COMPANY
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NOW A *New* "TH" TRANSTAT

SMALLER AND LIGHTER THAN EVER BEFORE!

NOMINAL LOAD 300 VA, 50/60 CYCLES, 115 VOLTS INPUT, 0 TO 115 VOLTS OUTPUT

MAXIMUM LOAD 340 VA 50/60 CYCLES, 115 VOLTS INPUT, 0 TO 130 VOLTS OUTPUT

MAXIMUM BRUSH CURRENT 2.6 AMPERES

With this new model, many smaller communications and industrial applications can have Transtat's smooth control, high efficiency and ruggedness. An ideal component, this transformer—type a.c. voltage regulator is but one-half the size and less than one-half the weight of the smallest previous TH Transtat.

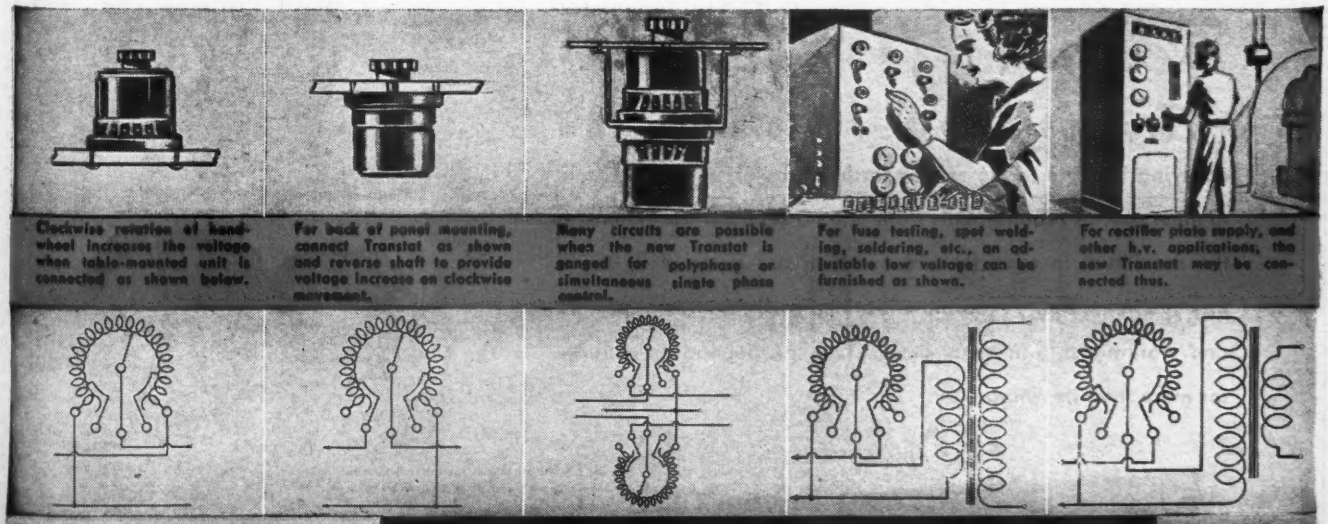
UNIFORM—Interchangeable Bakelite Bases

In addition to the well-known Bakelite closeness of tolerance, these bases have insulating barriers between terminals to prevent shorting of leads.

FLEXIBLE—New Brush Assembly Facilitates Mounting Changes

The unique brush arm shaft mechanism provides ease of change from table mounting to back of panel mounting or ganging. Die cast brush arm permits quick brush changes, improves heat dissipation and has generous brush contact area. Other features include extra wire insulation and impregnation of core and coil with special synthetic phenolic varnish. For complete details write for bulletin.

AMERICAN TRANSFORMER COMPANY, 178 Emmet St., Newark 5, N. J



Clockwise rotation of handwheel increases the voltage when table-mounted unit is connected as shown below.

For back of panel mounting, connect Transtat as shown and reverse shaft to provide voltage increase on clockwise movement.

Many circuits are possible when the new Transtat is ganged for polyphase or simultaneous single phase control.

For fuse testing, spot welding, soldering, etc., an adjustable low voltage can be furnished as shown.

For rectifier plate supply, and other h.v. applications, the new Transtat may be connected thus.

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

AMERTRAN

AMER-TRAN

Burke Bracket Type D.C. Motors and Generators. Sizes 1 to 1000 K.W.
Burke Motor Generator Sets Induction and Synchronous motor drive. Sizes 1 to 1000 K. W.
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Burke High Cycle Motor Generator Sets, Induction or Synchronous motor drive, with direct connected exciters. Sizes 5 K.W. to 500 K.W.

Designed for the Job

BURKE offers to industry a highly specialized experience in applying its wide range of standardized motors and generators to meet specific requirements from one horsepower up. Wherever the maximum in capacity and overload are demanded, it will pay you to get Burke's recommendation, for Burke stresses quality and workmanship in every detail. You can depend on a Burke for more than its rating.

MOTORS 1 TO 1500 H. P. • GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • *Since 1891*

there is a leader commercial unit for every type *of Installation*

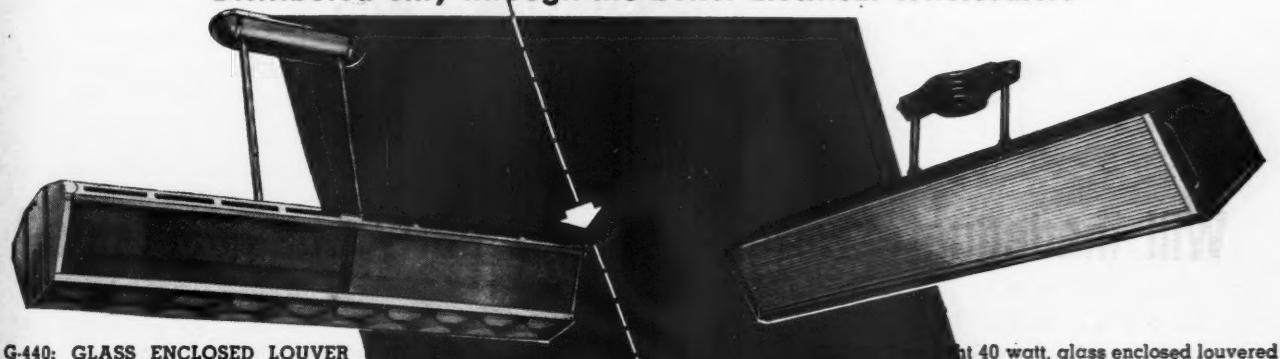
Is your problem low cost or simple streamlined beauty . . . fast easy installations or coordinated architectural design? Leader commercial fixtures can solve your problem.

Leader units are specified and installed nationally by leading architects and engineers. Maintenance men find them easy to service, rugged, long lasting and efficient.

Straight line wholesale distributor merchandising methods plus full Leader cooperation assures maximum profits.

Descriptive literature furnished on request or contact a Leader representative.

Distributed only through the better Electrical Wholesalers



G-440: GLASS ENCLOSED LOUVER unit is especially designed for offices. louver design permits full downward lig without side glare. Streamlined and more than similar units of equal light intensity

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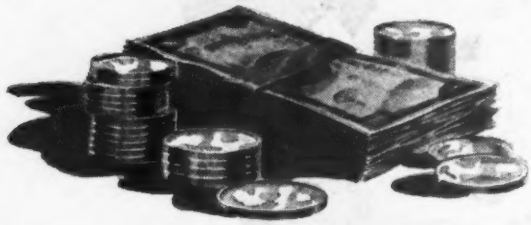
VO-440: Four light 40 watt, parallel tube, c luminaire. Remarkably simple to install, mai service. Available for pendant suspension mounting, continuous run or individual i

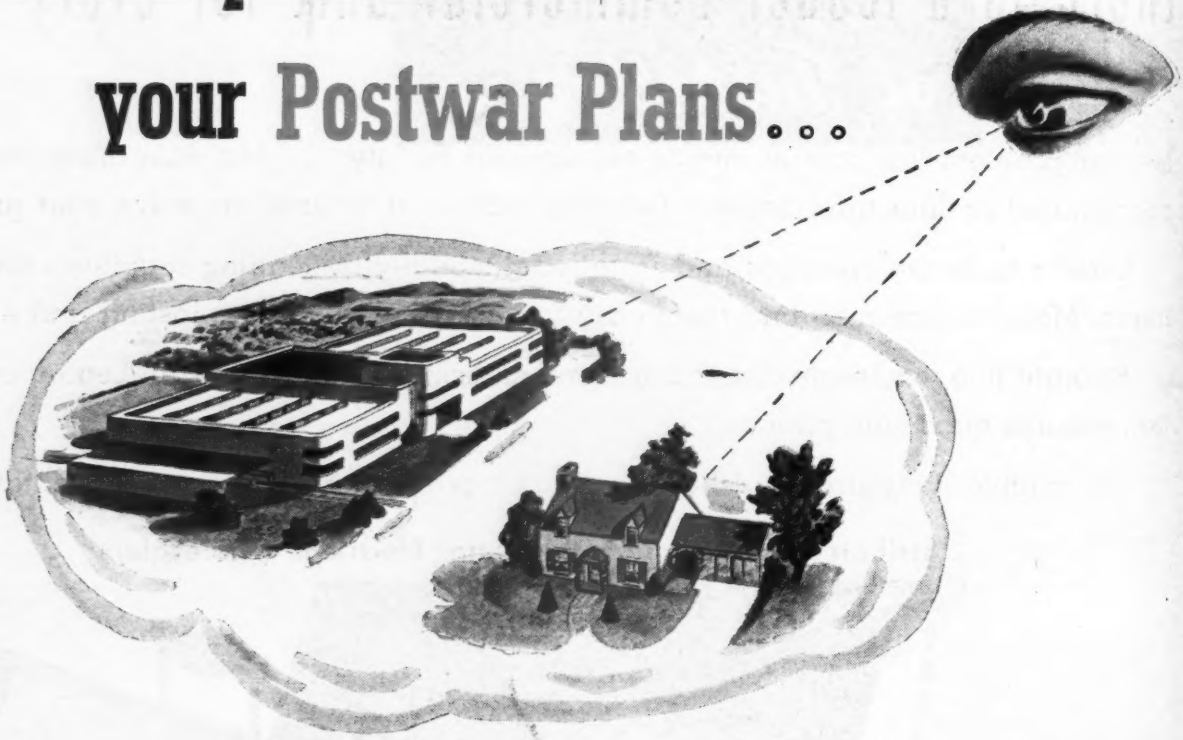
FICER – Four light 40 watt d unit, combining the finest nd servicing feature, this unit ighting equipment. Available or ceiling mounting, individual llation.

Leader adway, chicago 40, ill.

(Here's another ad in the series that brings a vital message to your customers.)



When your banker scans your Postwar Plans...



Will inadequate wiring suggest early obsolescence?

• Poor roofing and plumbing are obvious features that label a property a "bad risk" for financing. Inadequate wiring, although not always so obvious, counts for even more.

Naturally you want to guard against early obsolescence—whether it's a home or a factory. And of course you want to be able to take full advantage of all the electrical possibilities ahead... from finger-tip home conveniences to latest power devices for efficient manufacturing. For either or both – adequate electrical wiring must come first.

Make *sure* of expansion capacity—peak efficiency from electrical circuits, service equipment. Now is the time to bring these important factors into the planning stage: your consulting engineer, electrical contractor, utility power engineer.

Unwired planning will cost you a lot more than planned wiring. 44242

ANACONDA

HELP BRING VICTORY SOONER • BUY MORE WAR BONDS

ADEQUATE WIRING SERVES AND SAVES — KEY TO POSTWAR PROGRESS

ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York 4... Sales Offices in Principal Cities

Electrical Wires and Cables of Copper are the Life Lines of our Nation

IT'S EVERYBODY'S CODE

Out of the industry forums of this month and those to follow, from contractors' and inspectors' meetings, and from committee sessions and conferences over the country will come a body of recommendations for revising the National Electrical Code. The next edition, the 1945 revision, is now under consideration and article committees are at work drawing together the experience and thinking of all segments of the electrical industry and the public toward the further progress of the Code as a working instrument in the protection of life and property.

Code revisions are always important—personally important to every man in the electrical industry. And the coming revision is even more important because the 1945 Code is essentially the postwar Code. It will become effective when industry is turning away from the business of war toward the ways of peace. The experience of war wiring and material shortages will be behind us in all probability. The vast potential of postwar markets for electrical development and progress will be ahead.

The procedure of Code making and revision is substantially democratic. Many varied interests are represented on the Electrical Committee. And its individuals, in turn, are willing and anxious to represent the best thinking and most expert judgment of their respective segments of the industry and the public interests. They are expertly qualified men capable of making decisions, alone if necessary, on the many and complex problems of Code principle, policy or detail.

In a work so broadly affecting the whole industry, these men should have much more help, counsel and support from the people they represent than they have had in the past. Code work is always exacting. Too often it is thankless.

We often hear individuals complaining that "they" ought to write this rule or eliminate that requirement, as though the Code were drawn by some arbitrary, capricious and remote body. Yet constructive help and criticism is not only welcomed but earnestly sought by the men who have taken on the responsibility for keeping the Code up-to-date. They find industry indifference and perfunctory committee work harder to handle than the complaints of critics or the pressure of special interests.

The mechanism and established procedure for the 1945 revision is in action. The doors are open. Sincere, sound and progressive suggestions leading to a better Code and better protection of life and property from electrical hazards will have a fair bearing and earnest consideration. It's everybody's Code. And we all have a responsibility to make certain that it is the best we know how to draw.

Wm. F. Stuart

40,000 Architects and Builders Got This Message!

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definite ideas as to
and good business.
investigation of every
sed conditions and
he word was passed
considered as completed
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longed. Other reports
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Where Their Instinc
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match their natural instinct
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to good advantage by putting
storerooms. In this and other
done good work as porters.
where neatness and orderliness
ements, and it is a safe bet that
better than most men.
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may be debatable. The fact
n have had little training or
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compete with men, particularly
based on experience is important
facts in mind
to avoid
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FOR A Preview OF NEW ARRIVALS
that affect your Electrical Planning
JOHN WATTS
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CALL ON "JOHN WATTS"
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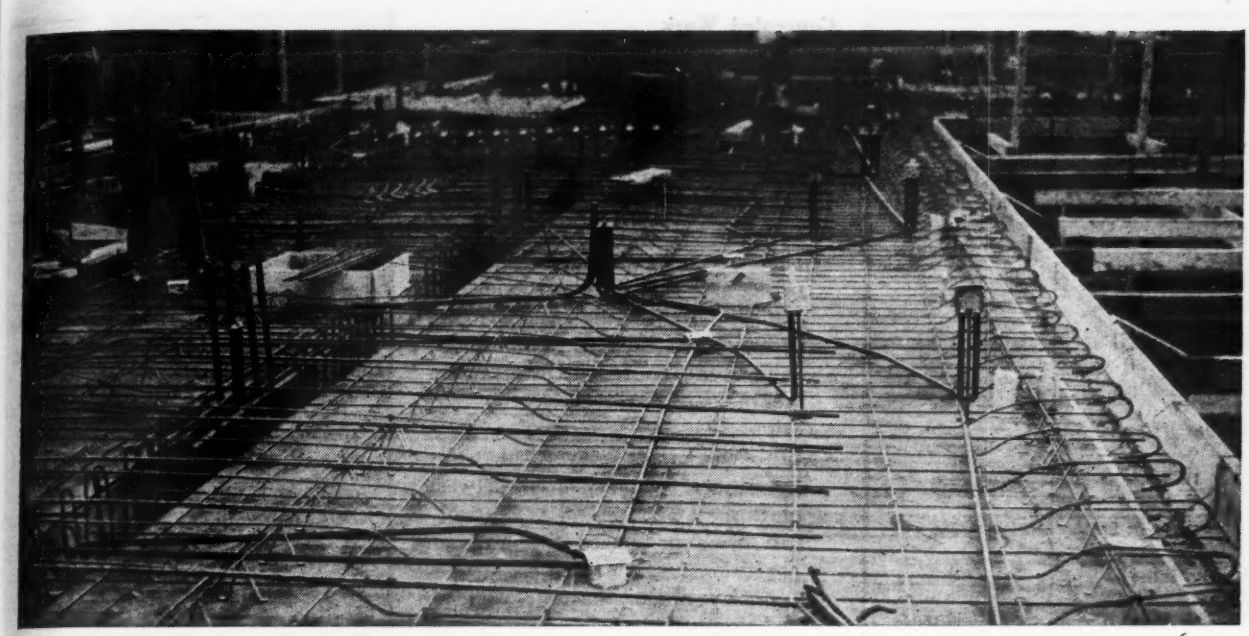
Right now, while plans for tomorrow's building are in the formative stage, is the time to call in John Watts, a qualified electrical contractor. You will find him well informed about the new electrical trends which may affect your plans.
After all, his primary business is to keep abreast of the latest developments in new devices, materials and techniques as soon as they are made public. All this data is at your disposal through alert, forward-looking electrical contractors, right in the community where the work is being planned.
It will pay you to work closely with a qualified local electrical contractor whenever plans for the future are under consideration. The "preview" he may be able to give you of tomorrow's electrical developments can affect your decisions today. And, when the time for action comes, you will find him ready with the best of the new electrical products, supplied via GRAYBAR.
5508
Give Your Electrical Work to "John Watts"
a qualified electrical contractor — heading a well-established firm with the trained organization, tools and know-how to give you specialized assistance on wiring, lighting, signaling, power supply, electronics. From offices and warehouses in over 80 cities, GRAYBAR serves a nation of JOHN WATTS, helping them to help you by supplying the newest and best in electrical materials.
GraybaR
Executive Offices: Graybar Building, New York 17, N. Y.

This Graybar advertisement, appearing in the August issue of the Architectural Forum, tells the electrical contractor's story to over 40,000 of your customers . . . the architects, general contractors and other leaders in the building industry. It urges them to work with you today on planning the jobs you both will be doing tomorrow, so that you and they may profit.

To help you do a good job, you will find your co-operative Graybar Man ready to help you with up-to-the-minute information and electrical supplies.



TYPICAL CONCRETE FLAT SLAB installation showing conduits and outlets before concrete is poured. Conduits may be turned upward or downward to feed outlets above or below the slab.

ESTIMATING

Conduit Work—Part I

A discussion of factors that estimators must consider to accurately figure conduit work. This first article deals primarily with branch circuits in flat slab construction. Labor units are based on actual installation experience.

By Leo W. Witz

Continental Electrical Construction Co.
Chicago, Illinois

A labor unit by itself is valueless to the uninitiated. Even to the experienced estimator it means little unless he has a knowledge of what is behind the unit—the operational functions it embraces; the experience that lies behind the development of the unit; the ramifications of its application. Those estimators who break jobs down into component parts and functions and apply prescribed labor units to each operation have the tremendous advantage of knowing just what an installation is going to cost before they place their bid. Unusual job conditions, for which no units have been developed, are covered by applying what might be termed a "Job Factor". The "that ought to take so much labor" method of figuring electrical installations is a thing of the past—or should be.

We, in our organization, have always subscribed to the "labor unit" system of estimating and have evolved our own tables of units from actual job experience. That is why we are now instructing our employees along these lines, giving them the background of what the units actually cover so they may make intelligent use of them in the future. The material presented in this and subsequent articles is a summary of notes and data presented to our estimating class.

The use of fixed labor units for the installation of rigid conduit applies to all component parts of a completed labor operation, regardless of their installation sequence. It has been frequently stated that the installation complexities are such that no fixed units can be applied. The defense of the unit system is simple. The estimators who rely on personal familiarity with a given condition to allocate labor to a particular operation, are using a "labor unit" even as they deny its adequacy.

The solution lies in preparing a flexible system to cover the various conditions encountered in different installations. Such units should be subjected to frequent checks for readjustment. As a precaution, it is well to weigh the unit, arrived at by "test", against the completed job labor. Frequently it will be found that the mechanics allegedly install the materials considerably under the unit values in question. When completed,

TABLE I STRAIGHT RUNS IN FLAT SLAB	
Conduit Size	Man Hours per 100 ft.
Branch Circuits	
½-inch	2.4
¾-inch	3.0
1-inch	4.4
Feeders	
1¼-inch	5.5
1½-inch	6.6
2-inch	8.8
2½-inch	11.0
3-inch	15.0
3½-inch	16.7
4-inch	17.6

NOTE: Units apply to heavy and thin-wall conduit. Cutting, threading and bending are covered by separate units for 1¼-in. conduit and larger and are included in the outlet units (Table II) for ½ to 1-in. conduits inclusive.

the actual job labor is in excess of the total labor based on the units. This is due to a large factor of non-productive labor which should be covered by the units.

The use of labor units presupposes their application by an estimator who is qualified to make an adequate and detailed breakdown of all the materials and functions to be incorporated into the construction. It further presupposes an intelligent analysis of the conditions to be encountered and ingenuity on the part of the estimator in fabricating relatively accurate units for certain work which is foreign to normal installations and for which no units have been prepared from experience. The system under consideration is definitely not an estimating panacea. It requires a detailed study of job conditions, a study of the type of available labor, and must be augmented by special costs which cannot be considered under standard labor units.

In applying the principles outlined above, it is necessary to consider all the possible conduit installation problems. In general, conduit will be installed under conditions described in one or more of the following categories:

Concealed Work

1. In floor forms erected for "flat slab" concrete construction.
2. In floor forms and shoring framework erected for "pan" type concrete construction.
3. On tile installed by others on adequate shoring, prior to the pouring of the concrete topping for "tile arch" type construction.
4. In columns erected to support concrete construction immediately above and poured to form an integral part of the entire construction.
5. In "side walls", (vertical walls, partitions, etc.), poured between forms.
6. In brick or glazed tile walls or partitions.
7. In clay tile or macolite walls or partitions.
8. In wood stud partitions prior to the final wall board or wood veneer covering.
9. In wood stud partitions prior to the final lathing and plastering.
10. Fastened to supported lath framework which will be heavily plastered to form a "solid plaster" partition.
11. On wood ceiling joists (which will be "furred" down to permit passage of the conduits without notching the joists), prior to the installation of:
    - A. Accoustical materials
    - B. Metal ceiling materials
    - C. Lath and plaster.

TABLE II CEILING OUTLETS IN FLAT SLAB		
	Man Hours Each	
Conduit Type	HEAVY WALL	THIN WALL
Ceiling outlet	0.55	0.33
1-in. Ceiling outlet	0.75	0.45
Junction Boxes (4- in. sq. or octagon).	0.55	0.33
Junction Boxes—11-B (4-13/16-in. square box)	0.75	0.45

NOTE: Units include labor for cutting, threading and bending conduit for two terminals per outlet and 3 splices (not to be included in wiring labor).

TABLE III OUTLETS IN WALLS AND PARTITIONS fed from ceiling slab conduits		
	Man Hours Each	
	Conduit	
Outlet Type	HEAVY WALL	THIN WALL
Duplex Recpt.	0.75	0.55
S. P. Switch	0.75	0.55
3-way Switch	0.85	0.65
4-way Switch	0.85	0.65
Clock Hanger	0.75	0.55
Fan Hanger	0.75	0.55
Bracket Outlet	0.60	0.40
Adjust. floor receptacle	1.30	1.10
Telephone floor receptacle	1.15	0.95

NOTE: Units include labor for two cuts, threads and conduit offsets (at wall outlet and ceiling junction) for two terminals; also installation of wiring device.

12. On wood ceiling joists where notching is required.
13. In a suspended ceiling—after suspended frame work has been installed and prior to the lathing and plastering of same.
14. In a suspended ceiling already installed, but which permits access between the ceiling and slab or floor above.

Open Work

1. On wood.
2. On concrete.
3. On steel.
4. On clay tile.
5. On suspended metal lath.
6. In suspended conduit racks.
7. In an open trench. (Although really a concealed job, this is considered because of accessibility.)

An analysis of the labor problems involved will reveal that, although the installations are entirely different, in many cases there are compensating factors which make the overall labor units on various types work so closely approximate each other that, for labor purposes, they can be grouped in preparing the units. Installations falling in the categories listed can be placed in definite labor groups with definite labor units assigned to them.

One important consideration is that the "rough" job be considered in its

entirety and the component parts of the whole labor job be divided into groups, such as "conduit", "outlets".

Concrete Construction

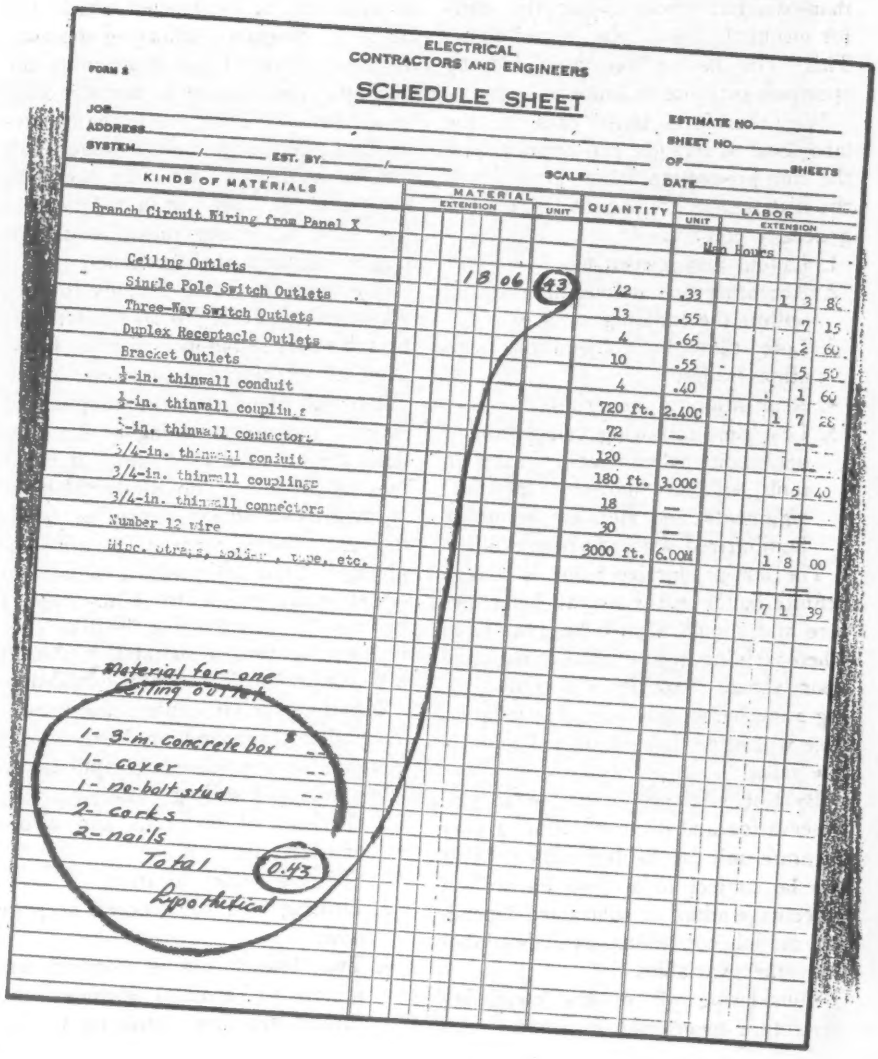
A most common form of concrete construction is the "flat slab" type. On jobs of this type, the branch circuit roughing is installed on the construction forms before the concrete slab is poured. The initial step is the spotting of the outlets. This requires a high degree of accuracy as any mistake will be irreparable without costly cutting of the slab. Plans on this type of work are usually well dimensioned and there are well defined fixed points from which to strike dimensions since beams outline flat slab sections and columns occur on fixed dimensions in the beam lines.

If the concrete slab is to be the ceiling, after the forms are removed, it is imperative that the outlet box be nailed firmly to the forms. A little additional care in mounting these boxes will save considerable time when the "finishing" job is done. Outlet boxes should be carefully selected to conform to slab thickness. After the exact center of the outlet has been established, drill a $\frac{3}{4}$-inch hole in the form to permit flow of any concrete seepage that may enter the outlet box.

One technique works very well. That is to loosely nail the box to the established location, install a no-bolt stud in the cover to be used, drop capped bushings or wood "corks" (to seal the conduits) and any required reducing washers that may be needed into the box and loosely fasten the cover. Thus everything is handy for the crew that installs the conduit. In completing their job they drive home the nails in the box ears and fasten the cover securely. The switch and receptacle outlets to be fed from the ceiling conduits must be spotted and a hole drilled in the form to accommodate a conduit "hook".

The work outlined above has all been done on a clear "deck", prior to the installation of any steel. The concrete outlet box knockouts near the top permit the conduits to clear the initial layer of steel, pencil rods, etc. Knowing the height of the first layer of rods above the form is important to proper selection of outlet box depths.

After the steel work has been started, the presence of the electricians can generally be very productive. The initial step on the part of the iron workers is to drop the column steel, install the heavy steel in the beams


ELECTRICAL CONTRACTORS AND ENGINEERS

FORM S

SCHEDULE SHEET

JOB
ADDRESS
SYSTEM / EST. BY /
ESTIMATE NO.
SHEET NO.
OF SHEETS
SCALE
DATE

KINDS OF MATERIALS	MATERIAL EXTENSION	MATERIAL UNIT	QUANTITY	LABOR UNIT (Man Hours)	LABOR EXTENSION
Branch Circuit Wiring from Panel X					
Ceiling Outlets	18 06	(43)	42	.33	1 3 86
Single Pole Switch Outlets			13	.55	7 15
Three-Way Switch Outlets			4	.65	2 60
Duplex Receptacle Outlets			10	.55	5 50
Bracket Outlets			4	.40	1 60
½-in. thinwall conduit			720 ft.	2.400	1 7 28
½-in. thinwall couplings			72	—	—
½-in. thinwall connectors			120	—	—
3/4-in. thinwall conduit			180 ft.	3.000	5 40
3/4-in. thinwall couplings			18	—	—
3/4-in. thinwall connectors			30	—	—
Number 12 wire			3000 ft.	6.00M	1 8 00
Misc. straps, solder, tape, etc.				—	—
					7 1 39

Material for one ceiling outlet

1- 3-in. Concrete box
1- Cover
1- no-bolt stud
2- corks
2- nails
Total 0.43
Hypothetical

FIG. 1—BRANCH CIRCUIT ESTIMATE illustrating the use of labor units found in Tables I and III. Note separate list of material and cost for one ceiling outlet which can be listed on reverse side of sheet for ready reference, for pricing and ordering materials.

and then to tie-in the beams with small steel rods over the flat slab. If the slab is not thick enough to accommodate the submains, they must be installed in the beams. Branch circuits, in general, can be run diagonally in the slab.

From the brief description of the job conditions it becomes apparent that the principal labor occurs at, or because of, the outlets. If the conduit alone were to be run in straight lines from one end of the building to the other with no interruption for outlets, bends, offsets, etc., the conduit installation would be relatively simple. To have a balanced system of estimating it is necessary that the labor units be allocated as nearly as possible to the operation in which they are involved. If the overall labor of an outlet job installation were divided in error, so that too much was charged against the conduit run and not enough to the outlet installation, the labor units would work perfectly for similar installations. But, on a long small conduit run, such as a telephone raceway system, the high proportion of conduit installation as against the relatively small number of outlets would throw the entire labor estimate out of line.

For the purpose of estimating labor, all tables presented here are based on *Straight Run*. The conduit labor units do not include cuts, threads, bends, conduit fittings, or fastening to outlet boxes. They cover only straight run labor including the necessary fastening to the construction. The same is true for the larger size conduits. Terminals, nipples, elbows, etc., are separate labor items. In the smaller conduits used for branch circuits, the labor for terminating, bending, etc., is absorbed at the outlet to reduce attendant "pencil" work. Where the small conduits are used on other

than straight circuit work, the units for terminals, bends, etc., would apply. This will be further amplified by specimen estimate to follow.

We, therefore, must consider the labor cost of straight run conduit, plus the non-productive labor involved in the installation. Non-productive labor generally consists of:

1. Layout and measuring.
2. Accepting and delivering material within the building or area.
3. Lost time in cooperation with other trades.
4. Requisitioning materials.
5. Lost time following completion of operation when men, material, tools, etc., are moved to new assignments, and men are becoming familiarized with the new task.

The non-productive labor is a very definite factor in the overall labor picture and should always be considered when arriving at any labor units based upon visual "experience". Questioning a mechanic as to actual installation time will often bring forth ridiculously low units.

By test, trial and error; by careful observation and documentation, a very accurate unit can be determined. This can be subject to a "Job Factor"—a percentage added or subtracted depending on job conditions, available labor and other variables.

Considering all of the conditions heretofore mentioned, a general table of units can be established which will make a compact estimating manual. Listed in Table I are labor units for *Straight Run* conduit in flat slab construction. All units are in man hours so that prevailing hourly wage rates can be applied to the total hours to determine the labor cost in dollars. For the sake of compactness, units for larger conduits are also listed.

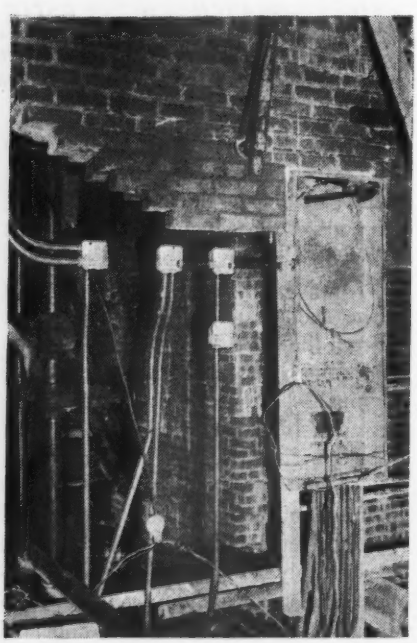
The units in Table I apply to both *Thinwall* and *Heavy Wall* conduit. At first this may sound inconsistent. However, an examination of either installation will show that the coupling of lengths and the fastening of the conduits are essentially the same in either type of conduit. The additional labor is involved in cutting, threading, bending, etc., and is covered by units applying to those operations (included in outlet unit for ½ to 1-in. conduit inclusive). This leads to the difference in labor between a complete *Thinwall* and *Heavy Wall* conduit installation.

On the type of construction under discussion the following items would have to be considered in applying a labor unit to a ceiling outlet;

1. Delivery of materials and layout of materials.
2. Spotting outlet location.
3. Drilling form for concrete seepage flow.
4. Two branch circuit conduit terminals. (Terminal includes cut, thread, reaming, fastening to box with locknuts, bushing, or connector).
5. Removing knockouts.
6. Two branch circuit conduit offsets.
7. Fastening the box.
8. Installing wood corks or capped bushings in the circuit conduits.
9. Installing cover and box stud.
10. Cleaning out outlet when forms have been removed.
11. Splicing average of three branch circuit wires. (Splices are included at the outlet to make the outlet labor unit compact. When estimating branch circuit wiring no consideration need then be given to splicing at the outlets.)
12. The above data would apply to the outlet regardless of the size of conduits used in the branch circuits. However, the labor units applying thereto have been compiled on an installation having 80 percent ½-inch conduit and 20 percent ¾-inch conduit. If 1-inch conduit is used in the branch circuiting, those outlets will require boxes with 1-inch knockouts which carry a higher unit.

The units listed in Table II for ceiling outlets, or junctions, in a flat slab construction cover a large number of labor tasks which, if not done in large volume, would be considerably higher than the units quoted. The job of installing ceiling outlets is so common that the average skilled mechanic can do the work with a high degree of efficiency. The units may appear inconsistent when viewed as an isolated job employing the various units for each portion of the ceiling outlet installation which would normally apply to similar cuts, bends, etc. But because of the high production factor, the non-productive labor is minimized and relatively low units result.

***OUTLET SUPPORTS** must be rigid and firmly anchored to forms and conduits wired to reinforcing steel to prevent "floating" and misalignment when pour is made. Sufficient labor should be allowed to do a thorough and complete job.*



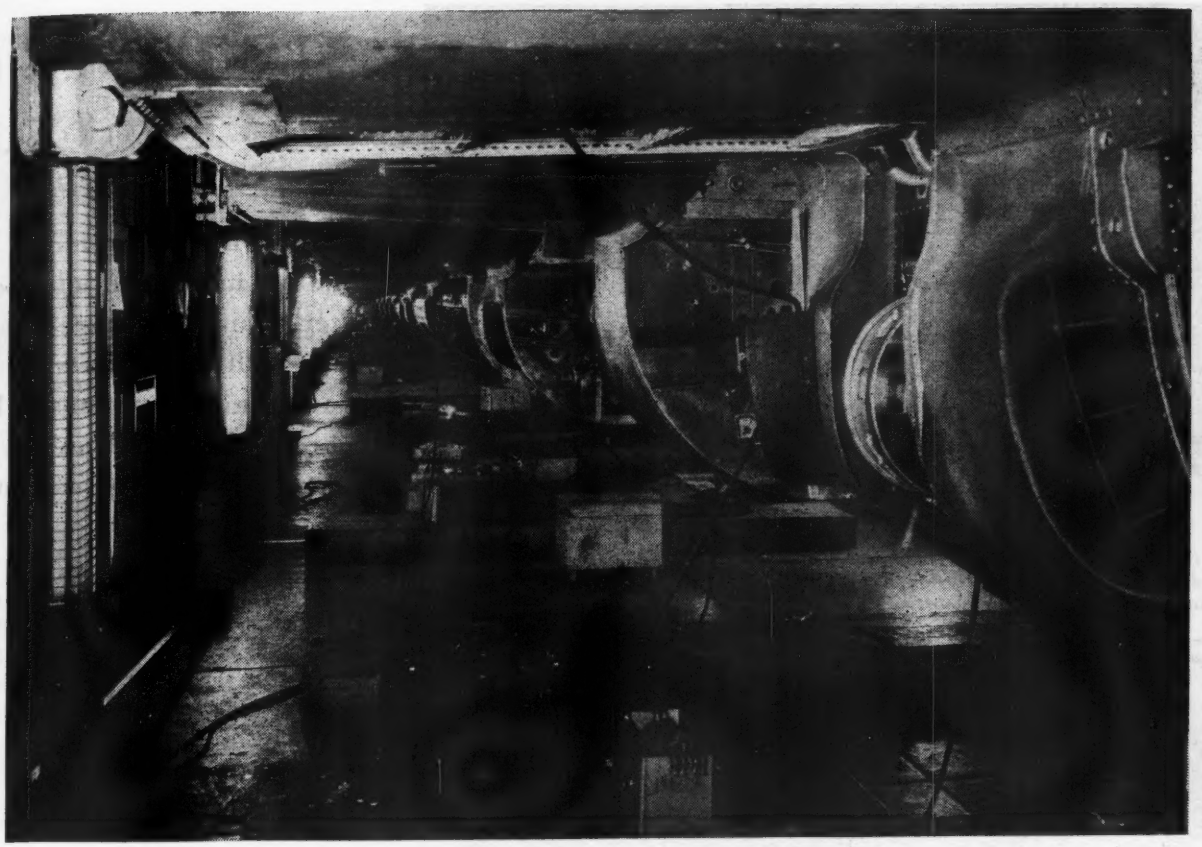
***OUTLETS IN PARTITIONS**, spotted and installed before the partition is built, require careful planning to prevent unnecessary chasing of concrete and brick to correct mistakes. Labor units should take into consideration this important factor.*

Wall Outlets

The installation of a switch, receptacle, fan hanger, or clock outlet roughed in from the ceiling conduit system and spotted in a partition to be built later, involves the following labor operations:

1. Delivery and layout of materials.
2. Spotting and outlet location.
3. Drilling form to permit conduit passage.
4. Installing bend on conduit to go through form. (This conduit should not extend over six to twelve inches below the form to permit easy removal of the form without damage to the conduit.)

[Continued on Page 169]



Underwing sections of big bombers are hidden from overhead lighting but fluorescent units mounted at frequent intervals along columns illuminate the area.

VERTICAL LIGHTING

Underwing aircraft assembly speeded with fluorescent units mounted on columns.

IN the large scale assembly of airplanes of considerable size where workers swarm over the working area, the problem of lighting is difficult. Overhead units, no matter what intensity, are shielded by wing sections or the large fusilage. Portable lamps mean additional trailing cords when there are already many for portable tools. They likewise cause local glare.

To light up the entire area about an assembly jig, Keese Engineering Co. of Los Angeles devised several types of fluorescent jig lighting units which are attached to permanent vertical or horizontal members. Douglas Aircraft Co. has made extensive use of these in its Santa Monica and Long Beach plants.

Use of fluorescent, though more expensive initially, is best for eye level mounting because of low surface brightness of the lamp. The fact that it is a line source rather than a point source also lessens the possibility of light being totally cut off by someone working in front of it. The entire working area, even under wing surfaces, is thus well lighted to much higher intensity and with less glare from a multitude of such lamps than would be possible by other means.

The fluorescent lamp or lamps are mounted on special elliptical reflectors, and are protected by a 1 by 3-in. wire mesh screen which gives protection with minimum loss of transmission. Daylight lamps give a cool appearance to the light which has a psychologically good effect on personnel, especially in summer.

Three types are used. One is a single lamp type. Another is the standard 4-ft., two-lamp fixture. The third type is a single lamp with remote ballast for mounting on small columns. Fixtures are mounted on column and overhead structural members of assembly lines and spaced as closely as possible.

Single lamp column units and two-lamp units mounted overhead furnish light on the sections and avoid shadows in the work area.

INDUSTRIAL E

INDUCTION HEATING UNIT rated 15 kw. heats the gear for 3.2 seconds and then quenches it. Hardened zone is uniform and follows contour of gear with core remaining soft.

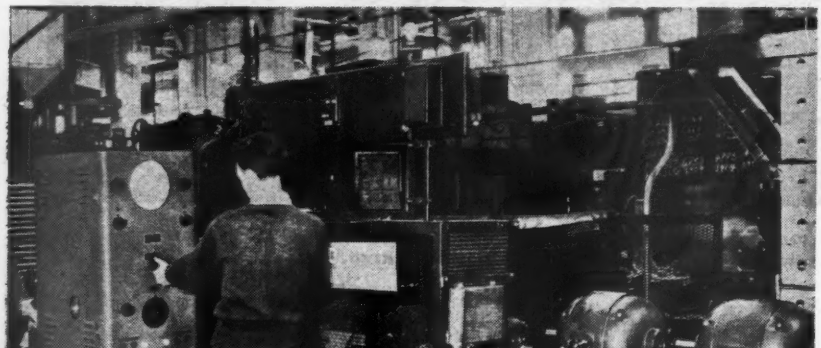
Electronic equipment is doing industrial jobs better than heretofore possible with other electrical or mechanical systems. Its breadth of applications is increasing at a great rate.

THE demand for greater and more efficient production to meet the requirements of war has given great impetus to the universal acceptance of electronic devices and equipment.

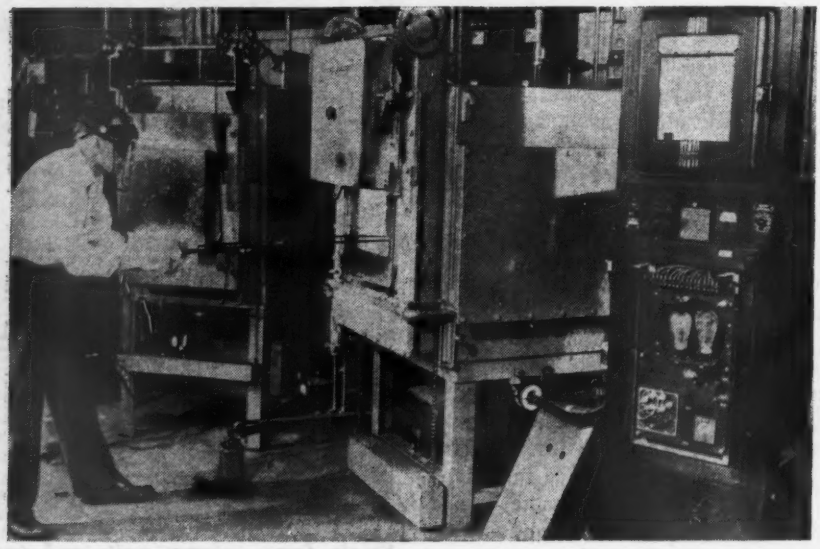
Electronics as a science dates back for centuries, but its history in terms of broad application to industrial processes covers only the past several years.

Some industrial operations that have heretofore been impossible can now be done automatically. Quantity and quality of products can now far surpass those manufactured by other methods used before the advent of such electronic equipment as high frequency induction and dielectric heating, electronic motor control and resistance welding, to name only a very few.

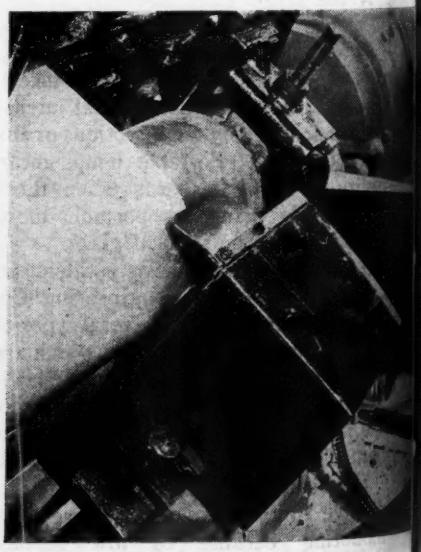
Heating time has been reduced from hours to seconds by the use of frequency heating. Speed ranges have



CATHODE RAY OSCILLOSCOPE incorporated in an insulation tester which records the performance of motor windings under momentary high voltage stresses.



POWER INPUT to this high-temperature furnace is electronically regulated by the General Electric Reactrol unit to provide precise temperature despite varying operating conditions.

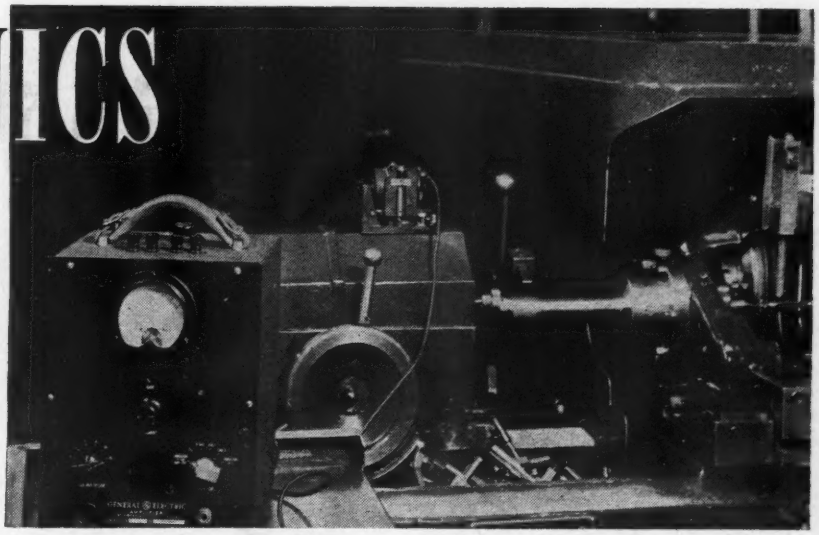


PHOTOELECTRIC side register control used to hold accurate edge in uniform coiling of steel strip.

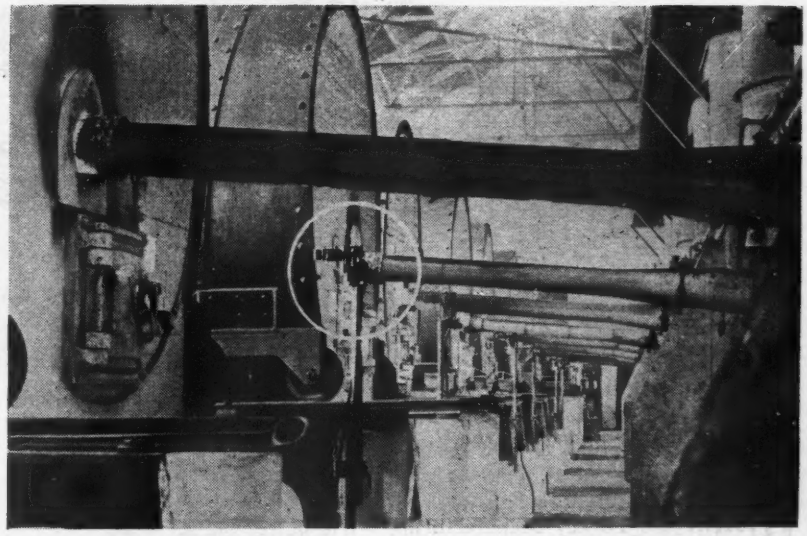
ELECTRONICS at Work

been increased considerably by electronic control. Metal sections can be joined by spot and seam welding for far greater strength and in much less time than by the older method of riveting. Timing intervals can be obtained in the order of fractions of cycles. Temperature colors can be read accurately and automatically, no longer dependent upon the human eye. And these are only a few typical examples.

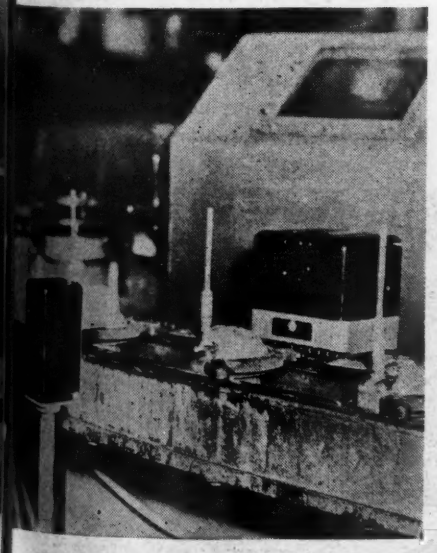
Electronic equipment must be considered in the same light as any other machine or device. It cannot be applied promiscuously. The electronic method should be compared with other methods as to first cost, operational costs and quality and quantity of product. In many cases the installation of electronic equipment will be more than justified economically; in many others it will not. Here it is a powerful tool in production, control, and maintenance.



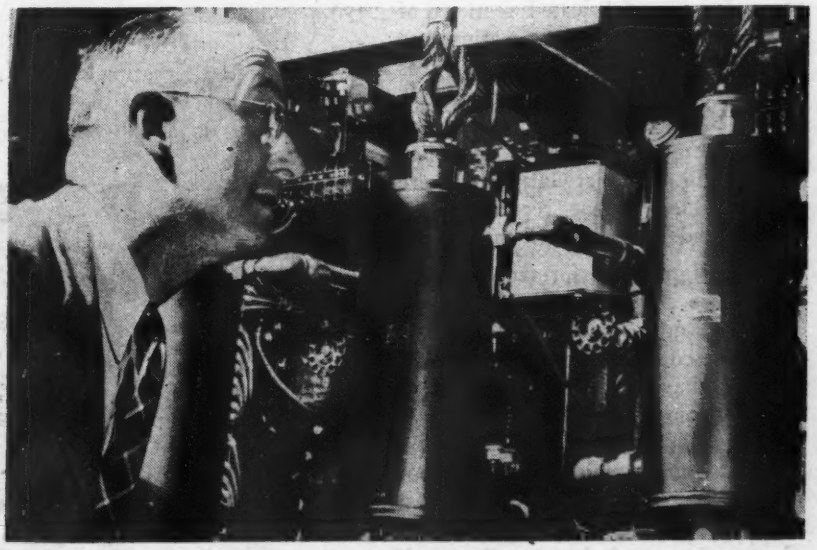
***VIBRATION VELOCITY METER** that detects both displacement and velocity of a vibration. Meter will indicate displacements as small as 0.0002 inches.*



***PYROMETER PHOTOTUBE** temperature control applied to cement kiln. The phototube operates on a color temperature principle to maintain a given heat.*



***PHOTOELECTRIC RELAY** is an inexpensive device for counting, controlling or limiting operations.*

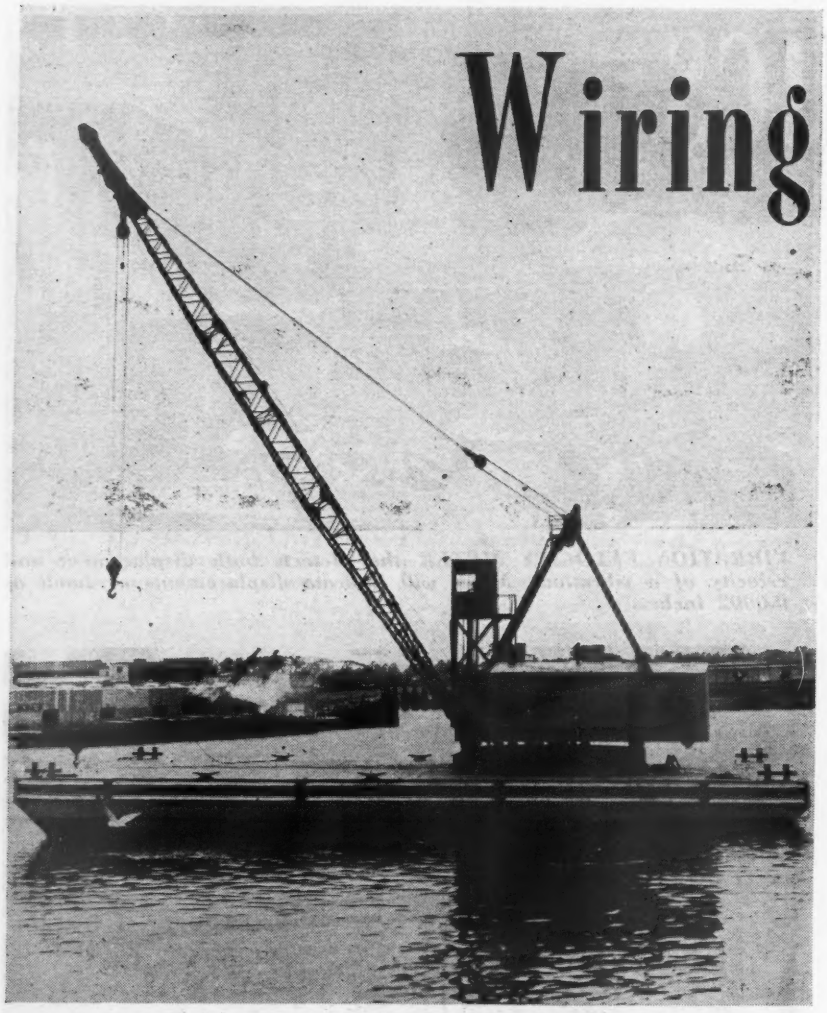


***SEALED IGNITRONS** are used in portable mercury arc rectifiers to convert a-c to d-c for such uses as crane service, coal-hauling equipment and machine tools.*

Wiring Diesel—

How Gulf Electric Company, prominent Houston electrical contracting firm, wired some 30 diesel-powered, electrically-operated cranes under subcontract to the Turney Manufacturing and Engineering Company, designers and builders of the units.

By August Eckel



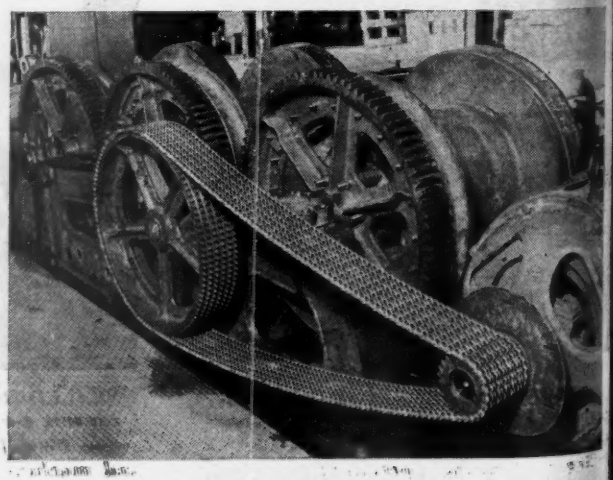
A 30-TON DIESEL-ELECTRIC BARGE CRANE, typical of those built by the Turney Manufacturing and Engineering Company and wired by the Gulf Electric Company for the U. S. Engineer Corps.

WHEN the Turney Manufacturing and Engineering Company, designers and fabricators of large shipyard cranes—the type used to swing huge prefabricated sections of ships into place for final mating and assembly—began supplying the yards in the Houston area, they subcontracted the electrical work to the Gulf Electric Company, also of Houston. The first 18 units that Gulf wired were of the all-electric type, receiving their current underground from the rails.

The design and performance of these units were so well received that the U. S. Army Transportation Corps soon ordered some 30 revolving cranes of a similar type equipped with a 120-ft. boom capable of handling 30 ton loads at a 65-ft. radius. Unlike the first cranes, which depended upon an outside source of current, these units—also wired by the Gulf Electric Company—were designed so they could be dismantled for use anywhere and carried their own integral, diesel-electric power plant.

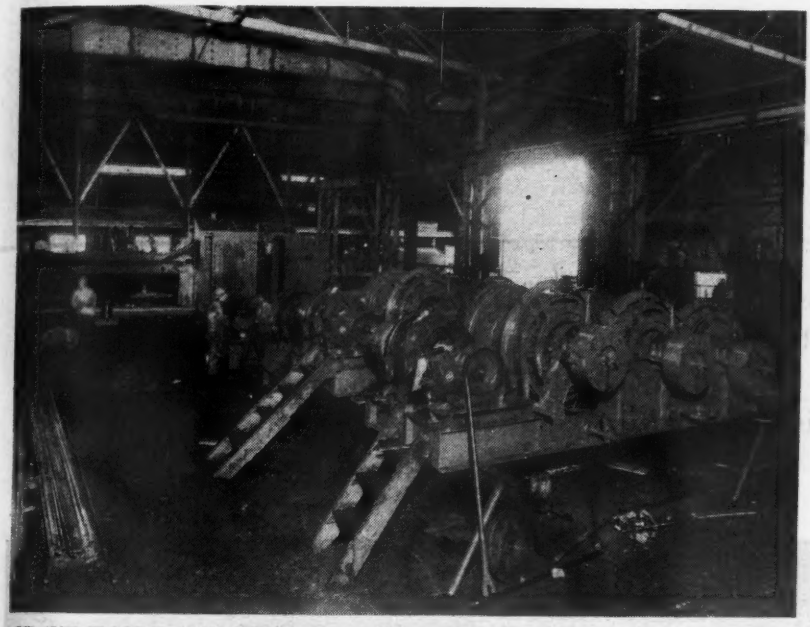
The entire operation of the crane and electrical system depends upon a compact power plant consisting of two, 120-hp., diesel engines as prime movers, V-Belt connected to a single, 150 kw., 440-volt, alternating current generator mounted between the units. The generator feeds a 440-volt, distribution board mounted in the center of the cab adjacent to one end of the hoist mechanism. It contains branch circuit breakers for the 150 hp., variable speed hoist motor; one 30 hp., and one 15 hp. motor for the swing mechanism; one 5 hp. air compressor motor and a 5 kw. air-cooled, 440/110-volt lighting transformer. The contactor board for controlling the hoist motor is mounted on a cab wall adjacent to the diesel engine compartment and because of the limited space, flat-type resistance grids are mounted to the roof of the cab. A small rectifier supplies the direct current for dynamic braking in the cab.

The lighting system, fed by the 5 kw. transformer previously mentioned, is of the single-phase, 2-wire, 110-volt type and serves the necessary lights in the crane interior and operator's cab

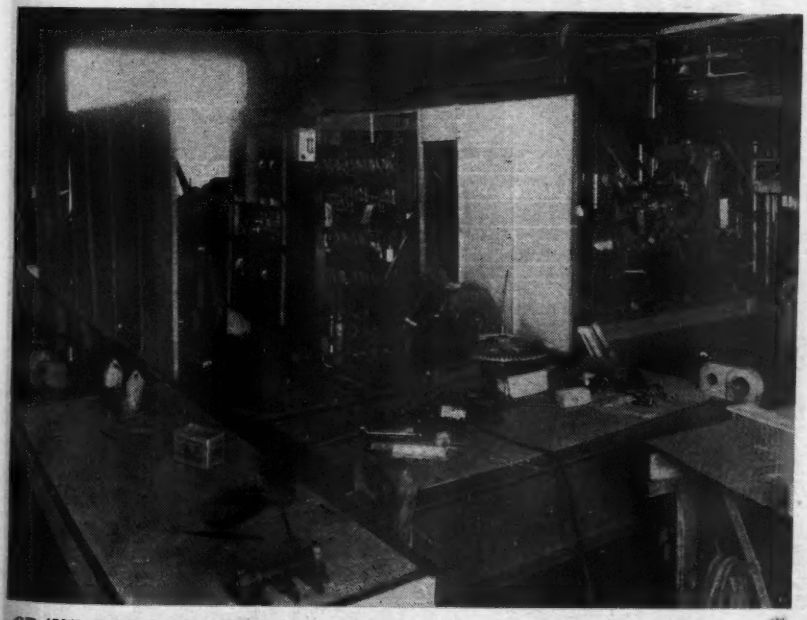


***TYPICAL DRIVE** hoist equipment is this sextuple width, silverlink roller chain and sprockets connecting the 150 hp., variable speed, hoist motor to the hoist drums.*

Electric Cranes



CRANE HOIST ASSEMBLIES complete with roller chain drive and a 150 hp., a.c., variable speed motor await mounting to cab floor.



CRANE CAB POWER PLANT consists of two diesel-engine prime movers (right, rear) driving a 150 kw., a.c., generator (hidden by right cab wall). Motors in foreground are for swinging cab on its turntable. Main 440-volt distribution panel is in center (hiding portion of hoist).

as well as four floodlights mounted to the cab exterior for night operation.

All electric motors are remote-controlled from the operator's cab, some 25-ft. from the switchboards and mounted high above the crane proper. A limit switch on top of the boom is tripped by a lug fastened to the hoist block cable to break the circuit of this particular motor before the blocks can become fouled. Other limit switches are installed to prevent raising the boom too high or lowering it too far.

Two prime considerations determined the installation technique of the contractor. They were: (1) the very limited working space in the crane cab and (2) the fact that the electrical wiring had to be sectionalized so it could be dismantled with sections of the crane for easy shipment to point of use. Fortunately, Gulf Electric had a first class mechanic on the job throughout the duration of the contract—one who could efficiently spot the equipment, organize the work routine for the 3-man crew, and work to the close measurements required. The wiring for the first unit was installed pretty much on the trial and error method. After completion, this unit was dismantled to carefully check shipping and crating techniques, then reassembled on a barge and put through a series of capacity and operating characteristic tests. The other units were closely patterned after this first "model".

W. G. POOLE who engineered and handled the crane wiring subcontract assignment for the Gulf Electric Co.

The sequence of equipment installation followed closely the progress of crane construction. As soon as the base and floor of the crane cab were built, the 2½-in. and 3-in. power circuit conduits were installed; next the distribution panel was set and, when the cab wall was up, the hoist motor contactor panel was installed. With the cab roof were installed the banks of flat-type resistance grids for the hoist motor control. The installation of the control circuits followed the completion of the operator's cab. Finally the lighting equipment was installed.

To facilitate easy dismantling and reassembly, all electrical connections were made with solderless connectors and junction boxes were installed at all points where the wiring had to be

[Continued on page 97]

LOOP FEEDERS For AIR DEPOT

The many repair docks, hangars, test cells and field lights spread over the area of Middletown Air Depot are fed by high voltage loop distribution circuits for stability, flexibility and capacity to meet rapidly expanding requirements.

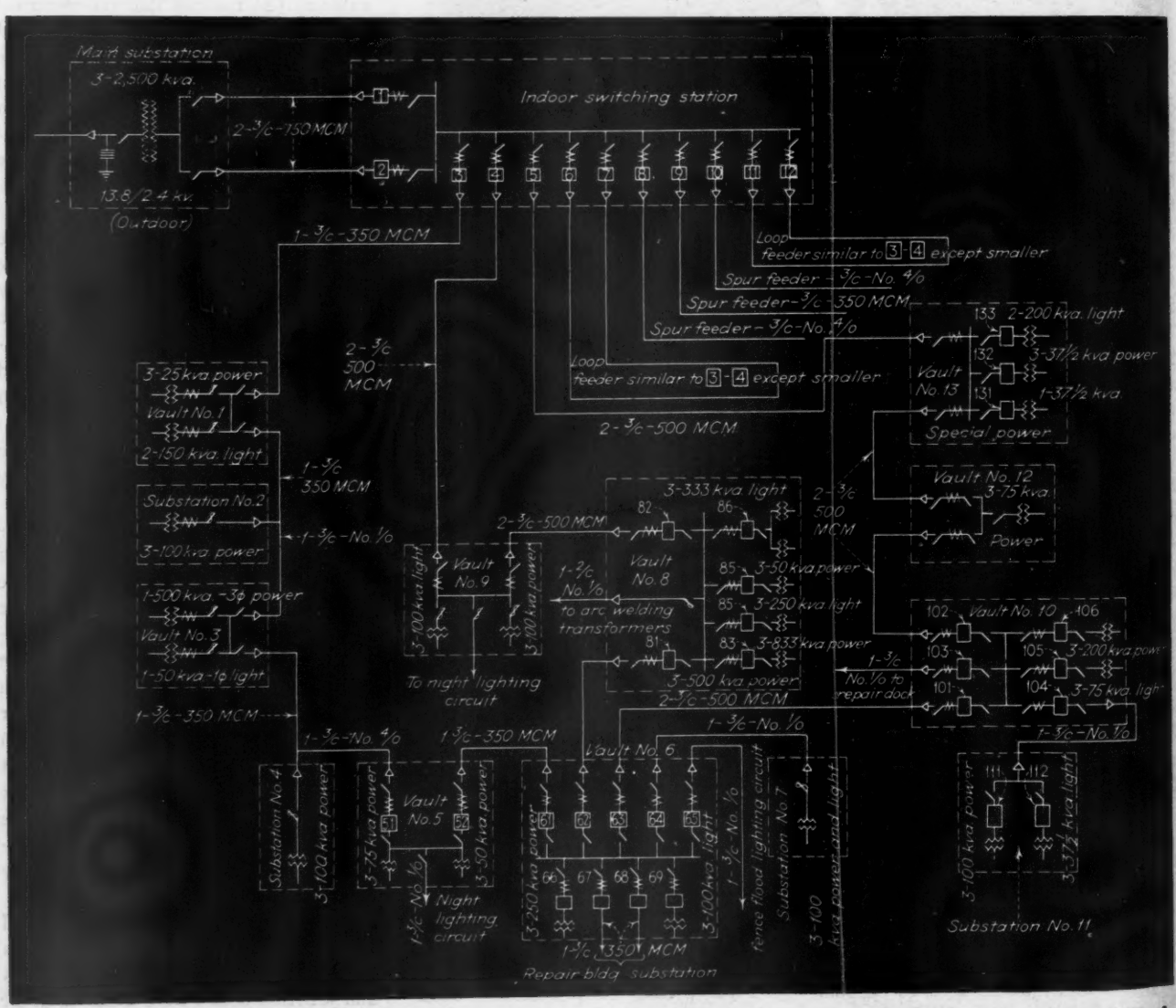
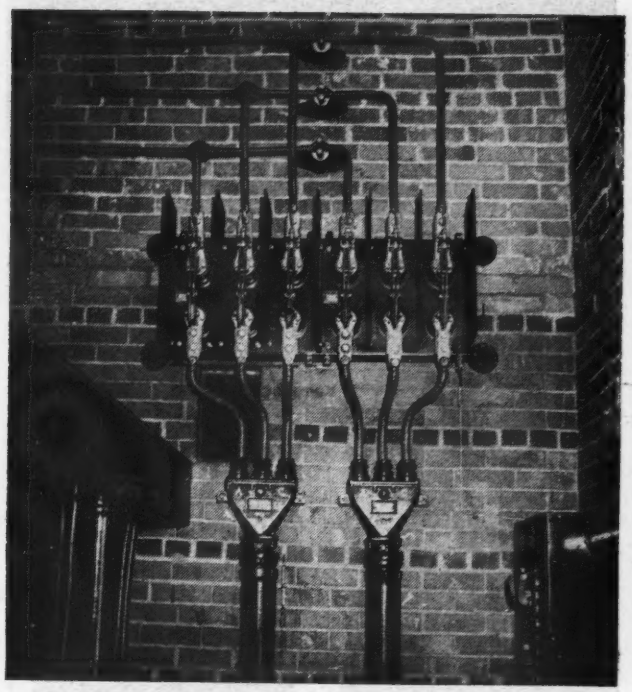


FIG. 1. Single line diagram of a portion of the high voltage distribution system. The loop feeder can be sectionalized at the various vault buses by oil circuit breakers. Note radial feeder tap off at manholes.

TYPICAL SWITCHING structure in one of the load-center vaults. The oil crcuit breaker is mounted at operating height; its current transformers and disconnects (hidden by arc-barriers) mounted in same section.



LOOP FEEDER on right comes into vault No. 1 from the switching station breaker No. 3. Disconnect puts feeder directly on vault bus. Feeder on left leaves through disconnect for vault No. 3.

EXPANSION of the air war program and the inevitable increase of aircraft casualties warranted the construction of a number of repair depots throughout the country by the Army Air Forces. Middletown Air Depot in Pennsylvania, one of the first to be built in the East grew in the manner of Topsy, for in the absence of experience data it was impossible to project the necessary repair facilities. Consequently construction started without detailed plans. The landing field was enlarged; buildings were erected; test cells, hangars and repair docks were put under construction. First estimates were far surpassed early in the building program as plane production increased beyond all expectation.

As an indication of this expansion, the architect's preliminary plans called for the installation of three 100 kva. lighting transformers and three 250 kva. power transformers in one of the many load-center vaults. The increase of load was so heavy in the immediate area as to finally require three 333 kva. and three 250 kva. lighting, and three 833 kva. and three 500 kva. power transformers. This amounted to an increase of 1,450 kva. of lighting capacity over the original 300 kva. and 3,250 kva. of power capacity over the original 750 kva. In some instances increases of 1,500 to 2,000 percent over preliminary plans were experienced, and consequently, rather than to try to revise the outgrown specifications, they were for the most part scrapped.

Construction was accomplished under Major Joseph C. Walker, Area Engineer for the Corps of Engineers. Because of expediency and because requirements were changing so rapidly, construction proceeded on conferences rather than blueprints. The finished plans generally followed the completed work. The resulting installation was magnificent from both an engineering and construction standpoint. Nor was it by any means a miracle, for both the engineering and construction staffs were manned by exceptionally able men who could coordinate the work and get on with the project.

Robert W. Johns, field superintendent of construction for Howard P. Foley Co., Inc., was in direct charge of the electrical work. Drawing on his long background in the electrical construction field, Johns projected for

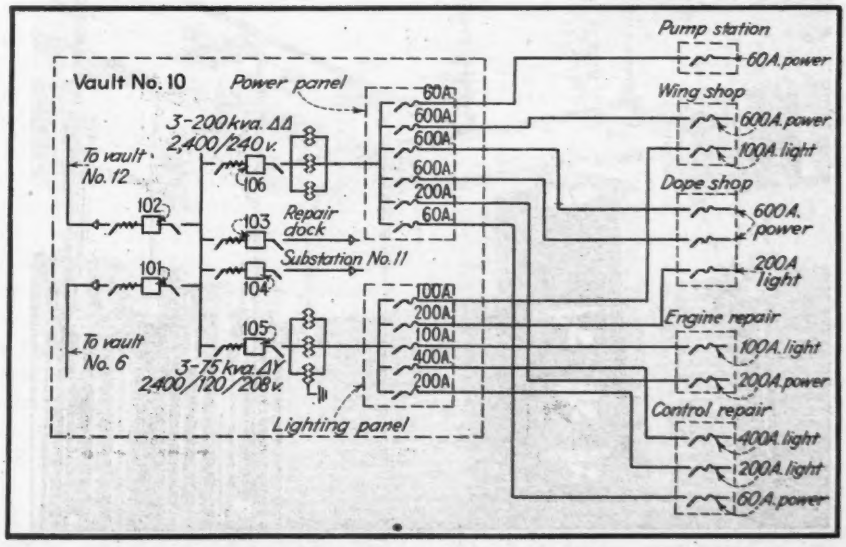
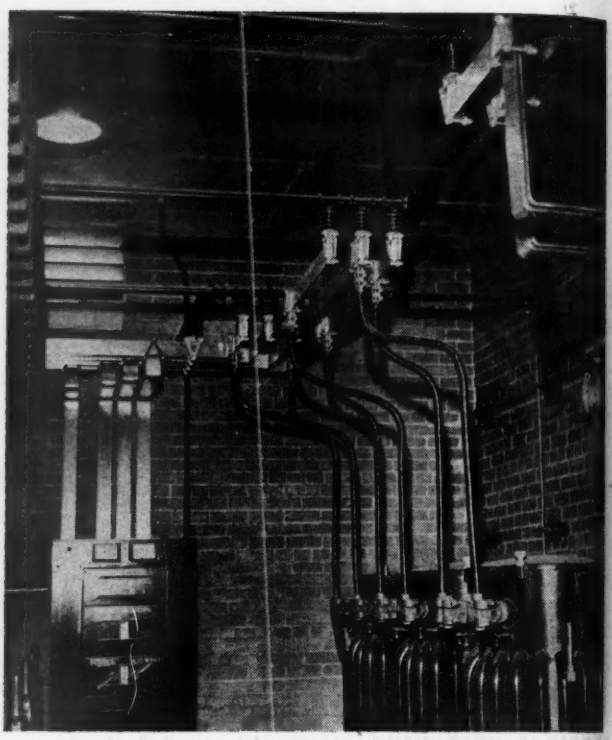


FIG. 2. Single line diagram of the secondary distribution from vault No. 10. The power and lighting feeders leave their respective panels and are taken to their respective utilization points in adjacent ducts.

CLOSE-UP OF POWER PANELS in corner of one load-center vault. Busbar is used for connecting panel bus to secondary station bus. Note clean-cut installation of bus and pipe work.

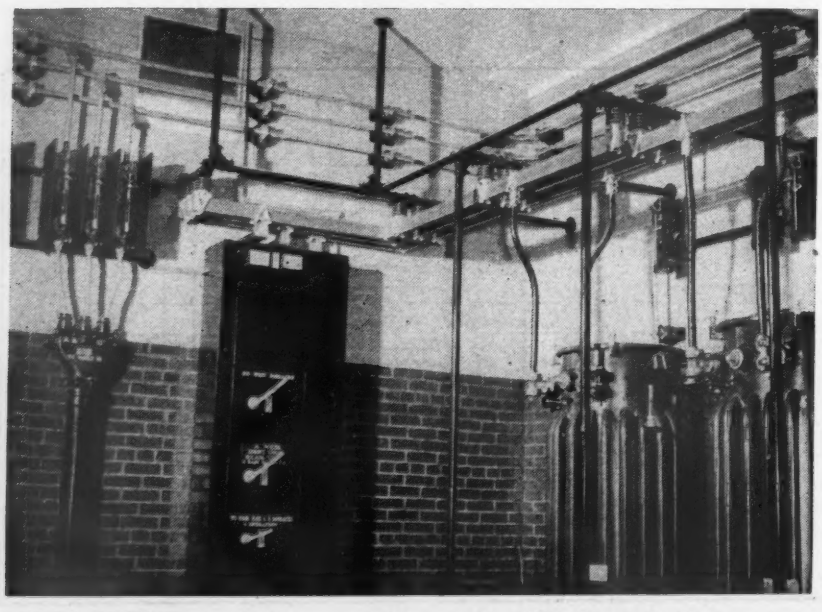


LIGHTING PANELS also use busbar drops from station bus to panel bus. All lighting panels are three phase four wire 120/208 volts. The transformer bank on right is wye connected with mid-tap grounded.

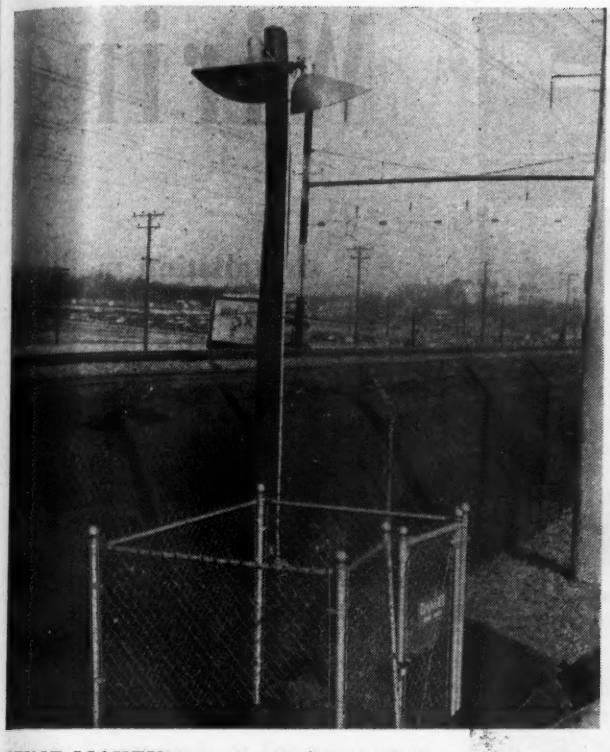
ultimate loads from preliminary estimates to obtain required capacities of cables, transformers, breakers and auxiliary equipment. His past experience in the industrial field of electrical construction proved highly valuable in successfully meeting the critical requirements of the Middletown Air Depot project.

Assistant Engineer John F. Behny, in charge of electrical design and inspection, did the liaison work between Major Walker and Bob Johns, working out details as construction proceeded.

As building sites were located, the electrical load-centers were spotted, capacities were estimated and projected, underground duct lines and manholes were laid out, and actual construction began immediately. As soon as cable-run lengths from manhole to manhole were determined, each length was ordered from the manufacturer on separate spools. Johns did this first to avoid any unnecessary waste of expensive and highly critical lead covered-varnished cambric three conductor cable, and second so that spools could be ear-marked and delivered to the manhole from which the pull was to be made. A great amount of time and material was saved by this simple expedient. Many other short cuts too numerous to mention and which fall into the category of contractor know-how, were contributed to the project by Johns. In one instance, two delta-delta connected power transformers banks (one 750 kva. and one 1,000 kva.) were to be reconnected delta-wye into lighting banks to meet an emergency condition. Manufacturers put themselves on record as saying the job could not be done in the field and consequently thought it useless to send out field engineers and mechanics. They requested that the banks be crated and shipped to the factory where they would be given preference and rushed back to the job. Total time required was estimated at six weeks. Johns picked several of his best men, moved the tanks under the ventilating tower of the low-ceilinged vault, hoisted the cores and coils, brought out the mid-taps through new covers with an



LOOP FEEDER on left connected to station bus through disconnects. Power panel in center feeds directly off secondary bus. Power transformers are on right. Note pipe framework for carrying bus.



FENCE LIGHTING is provided by a 3000 watt two-unit assembly on poles spaced 500 feet apart. A 2400 volt single phase circuit supplies 7½ kva. tubs at every third pole. Parkway cable is used for underground secondary.

FLOODLIGHTING BANK at end of runway. Note obstruction lights and transformer station in background. Floodlights and obstruction lights are on separate circuits controllable from the field control tower.

added bushing and had both banks operating on the line in a matter of several days. Johns himself worked day and night with the men to accomplish the task.

In another instance, when a power busbar bender could not be delivered in time, he designed and built a hand bender to form the station buses. The bender was made of heavy channel-iron bed with flat-steel framework handle and roller to do the forming. The hand bender was preferred by the mechanics and was used throughout until the completion of the project.

Distribution Design

Electric power is supplied to the main substation (out-door) at 13,800 volts and is transformed to 2400 volts for Depot distribution by three 2500 kva. units connected delta into a three phase bank. Feeders, which connect the outdoor substation 2400 volt bus with the indoor switching station bus, are duplicated as shown in Fig. 1. Each of the two mains consist of two parallel 750 MCM varnished-cambric lead-covered three conductor cable. Every inch of the thousands of feet of feeders are carried underground in Transite duct, and is V.C.L.C. three conductor cable. As shown in Fig. 1, feeders may consist of single cable runs, or where capacities or lengths of runs are too great, two cables may be paralleled.

The switching station bus under normal operation is energized by both main feeders through the oil circuit breakers. Branch feeders to the load-center substations leave the switching station bus through disconnects, O.C.B.'s and potheads. The switching station arrangement, as are all the high voltage switching equipment in the many substations, is like that shown in an accompanying photograph.

Oil circuit breakers are mounted at operating height, with each breaker's auxiliary equipment such as current transformers, disconnect switches and arc-barriers mounted directly above and within the same section. The required number of sections are fabricated in the conventional open pipe-and-connector framework. The station buses are hung from overhead pipe framework and are not enclosed. This provides better ventilation, increasing the carrying capacity. All bus work is highly polished and lacquered to prevent oxidation, to increase its radiating factor and to present a clean, neat appearance.

Referring again to Fig. 1, the various feeders emanating from the switching station may be either loop or radial feeders. Radial feeders serve only one load-center substation while loop feeders may serve as many as 13. One of the loop feeders serves only one large substation in a critical area. In this respect, it may be considered nothing more than a parallel radial feeder except that the runs take different routes. Either or both feeders may be used to carry the load in an emergency. Normal operation requires only one feeder.

Note that radial feeders also take off at various points on the loop. Sometimes taps are made in a manhole through which the feeder passes; in other cases the radial feeder will be taken directly from one of the station's 2400 volt buses.

In Fig. 1, follow the 350 MCM feeder from O.C.B. No. 3. Entering vault No. 1, the feeder emerges from the riser conduit through an indoor type straight-through pothead, across a disconnect switch and onto the vault's high voltage bus. The loop continues by leaving the 2400 volt bus through disconnects and pothead, into the underground duct, emerging again at vault No. 3. Note that substation No. 2 is fed from a tap made in a convenient manhole through which the loop feeder passes, whereas substation No. 7 feeds from the station bus of vault No. 6 through oil circuit breaker No. 64.

The loop feeder originating at oil circuit breaker No. 3 splits at vault

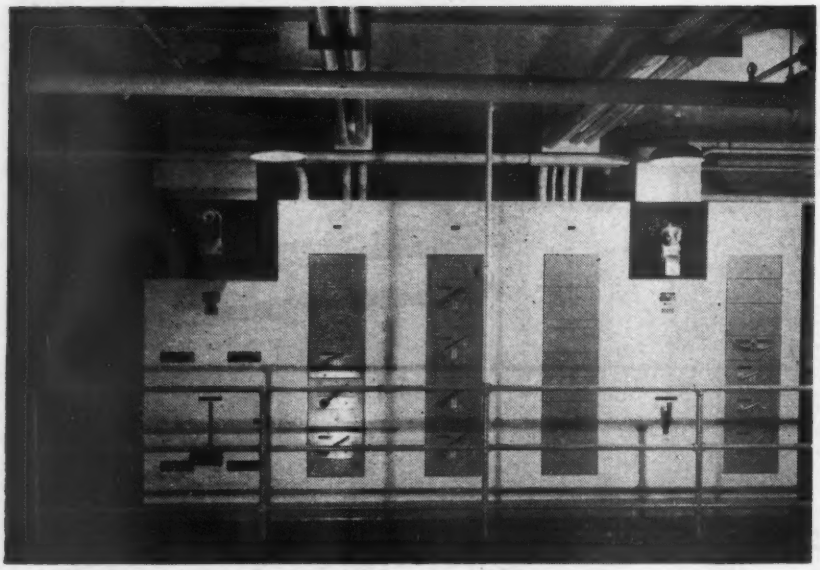
[Continued on page 167]

Wiring

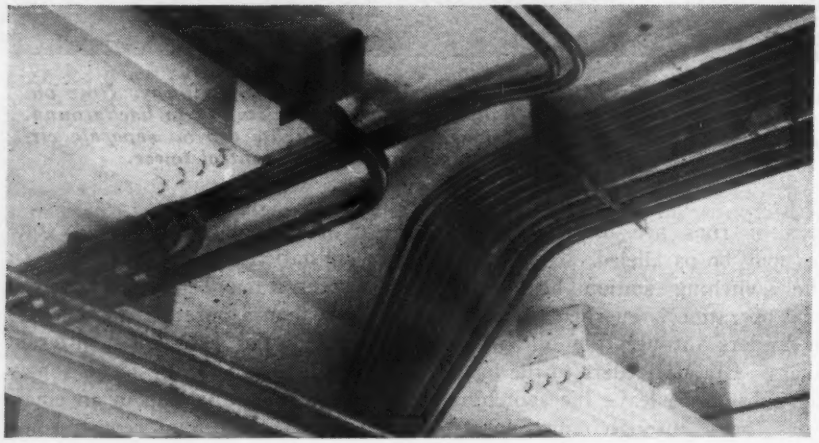
Installation methods at Kraft Cheese in Burbank provided

ESPECIAL care was taken by the engineer, Harve McMurry, of the Kraft Cheese Co., and Stolper Electric Co., of Burbank, Calif., in the installation of a new mayonnaise, French dressing and shortening making and packaging plant in Los Angeles. Because of the perishable nature of the food processed, extreme care was taken in the installation of all mechanical facilities to provide for cleaning and to eliminate all possible pockets in which bacteria might lodge. This called for some interesting treatment of the electrical wiring.

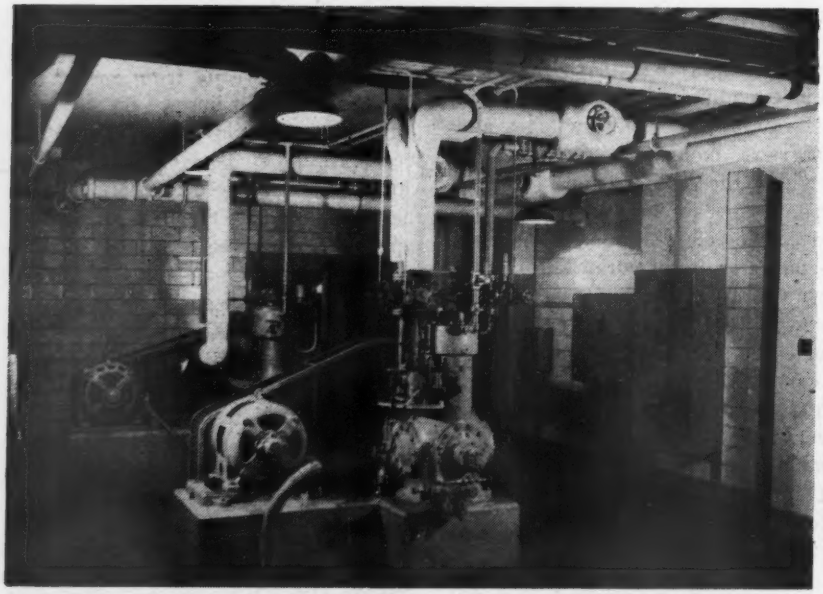
For example, the lighting and motor control panels, instead of being placed against the wall, were made-up assemblies mounted on 1½ by 1½-in. angle iron frames. These frames were put against the wall but permitted access behind the switch boxes for cleaning. The switch cabinets themselves were mounted directly to a piece of gutter with access between for steam cleaning. They were of a rugged, moisture-resisting type. After installation



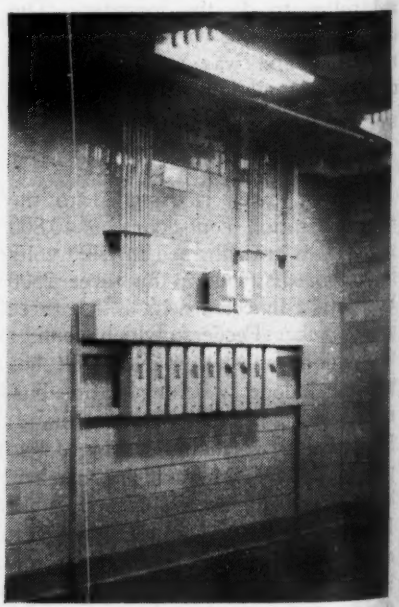
MAIN SWITCHBOARD, with the power main 1,600-amp. circuit breaker on the left, the lighting 600-amp. breaker and distribution switches on the right. Note the provision for future expansion.



SUPPORTS for the conduit and for the fluorescent fixtures were made of sheet steel drilled for the pipe to be supported. Note accurate conduit bends and nipples lined up. Picture was taken before painting.



AGAINST THE WALL is the control panel for the refrigeration system. It serves the two 40-hp. motors shown and a 60-hp. motor not shown driving the refrigeration compressors.



MADE-UP SWITCH PANELS are held away from the wall by being mounted on 1½ by 1½-in. angle iron.

for CLEANLINESS

for easy steam cleaning of conduits, panels and apparatus.

the whole assembly was painted to match the tile with which the interior was finished.

All conduit was neatly racked and required bends were made with a uniform radius. Pipe was cut also in such a way as to bring all pipe nipples neatly into line. The large pipes in each group were bent first by the contractor and then other pipes made to conform to that.

Supports for the pipe from the ceiling also differ from the ordinary pipe racks or hangers. Plates of No. 10 gage steel were drilled for the pipes they were to support, given a right angle bend and bolted rigidly to the ceiling. The illustrations show such supports.

It will be seen also that similar sheet steel supports were used to hang the fluorescent fixtures. These are all four-lamp, 40-watt industrial fixtures.

Control Mounting

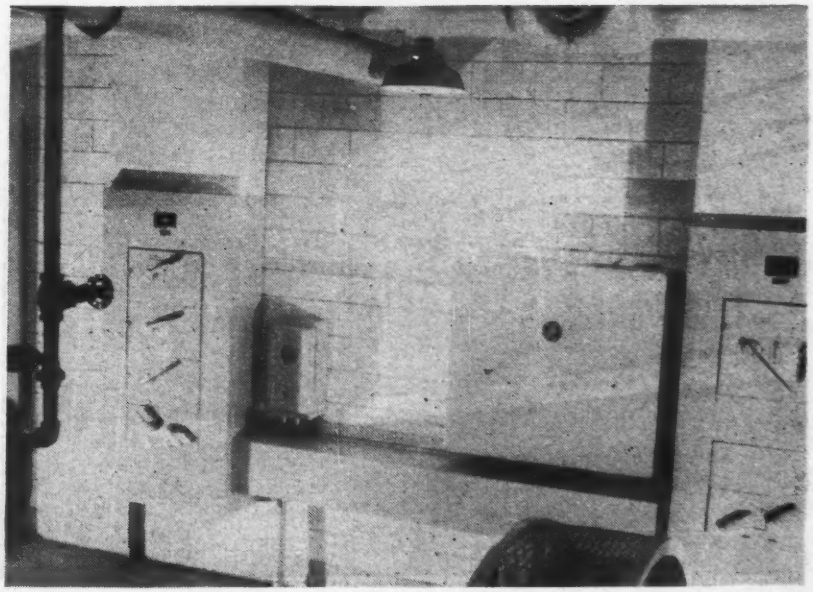
In the packaging, a number of conveyor lines are used. For controls on these conveyor lines Allen Bradley combination switch and magnetic starters were mounted in groups on short pieces of gutter which were suspended from the ceiling on 1¼-in. pipe. These were served by a conduit coming in from overhead and looping down to each gutter.

Pushbutton controls were mounted where necessary on the conveyor line, the control runs being placed in conduit underneath the conveyor and thus inconspicuous. In some instances remote control pushbuttons are suspended from a ceiling box in one room where the motor that is to be controlled from it is at the other end of a conveyor in another room.

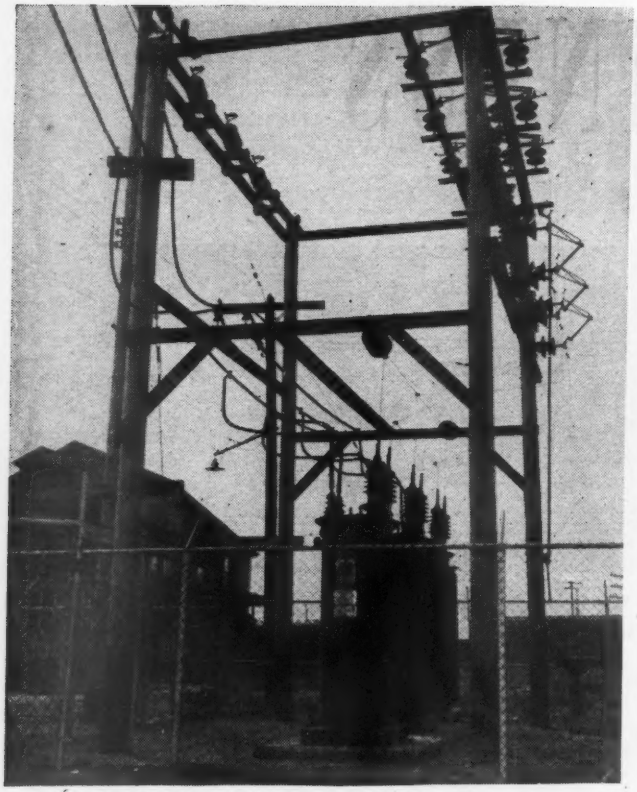
Learning of the job and being assured of it in time, Roy Stolper was able to order and have on hand before priority regulations and restrictions practically all of the equipment and

[Continued on page 134]

***CONTROLS** for the assembly and packaging conveyor lines are neatly grouped on a piece of gutter suspended from the ceiling on 1¼ in. pipe and served from overhead through a conduit brought down to the gutter.*



***CLOSEUP** of the refrigeration control panelboard, Allen Bradley starters and Bull Dog switches are joined to a gutter. Feeders come in through the troughing above each group of switches.*



ALL WOOD CONSTRUCTION of the substation with 400 amp. gang operated air circuit breaker mounted atop structure. Secondary drop to switch house is attached to pole on extreme left.

D.C. to A.C.

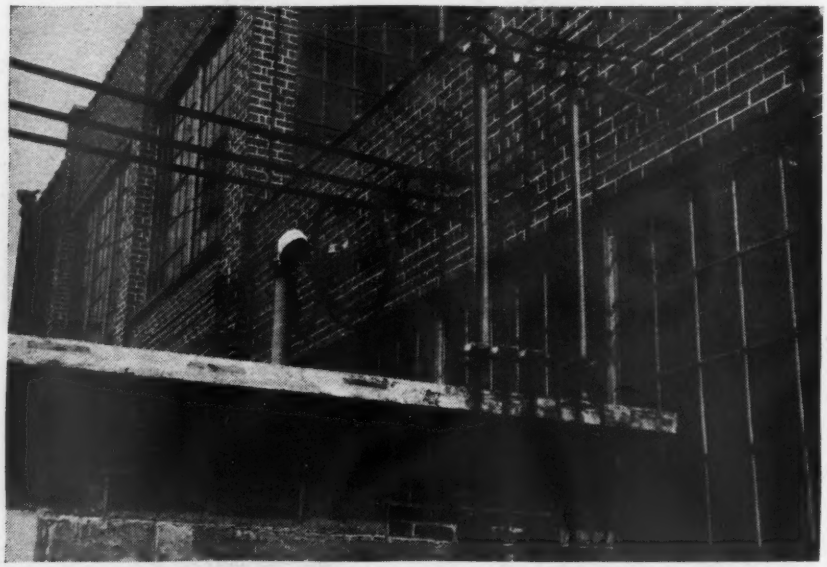
Plant lighting and part of motor load converted to a.c. to release d.c. for machine tool drive, and to take advantage of more modern and efficient light sources.

By R. E. Miller

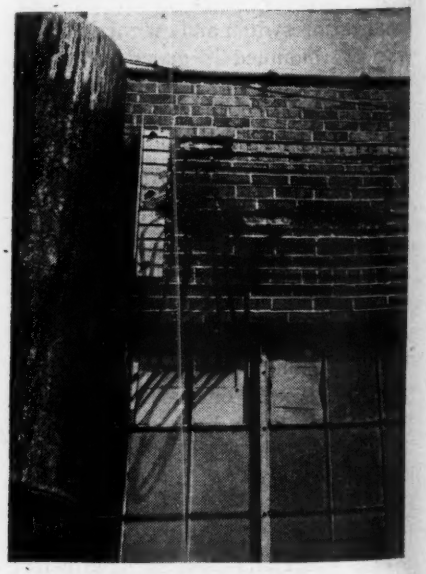
THE advent of war brought forth an avalanche of problems to industrials who found production schedules increased many fold almost overnight. Many who had always generated their own electric power were suddenly caught short to meet the requirements of an expanding war economy.

Clark Bros. Manufacturing Company of Olean, N. Y., until recently generated all their electric power requirements with 750 kw. and 500 kw. d.c. generators driven by diesel engines of their own manufacture. However, the sudden expansion of production soon found them wanting of more d.c. power to drive newly acquired machine tools.

Expediency being the order of the day, maintenance superintendent, R. W. Voslamber, elected to purchase a.c. power from the operating utility. Foremost among the reasons for this decision were: (1), to take advantage of the new and more efficient lighting sources namely fluorescent and mercury; (2) to conserve critical materials,



ATOP SWITCH AND METERING house note 750 MCM secondaries entering weatherhead. Power and lighting feeders emerge from side of switch house and continue along outside of building.



POWER AND LIGHTING feeders enter through window panes of insulating board.

Changeover

steel and copper; (3) generators were hard to get; and (4) diesels were badly needed for war.

The existing d.c. generators were subsequently relieved of 250 kw. of lighting load. In addition, 250 hp. of new and old motor load was placed on the a.c. feeders. By so doing, a sizable block of d.c. power was made available to new machine tools requiring d.c. drive.

All the d.c. lighting system wiring was removed except one fixture for every 2,250 square feet of floor space. These units remained on d.c. circuits for emergency lighting and were lamped with 300 watt bulbs in high bay areas, 150 watt bulbs in low bay areas.

All the existing plug receptacles and convenience outlets were left in operation on the 230 volt d.c. system.

The new substation was entirely of wood construction using four 30-foot corner poles with wood bracings and supports.

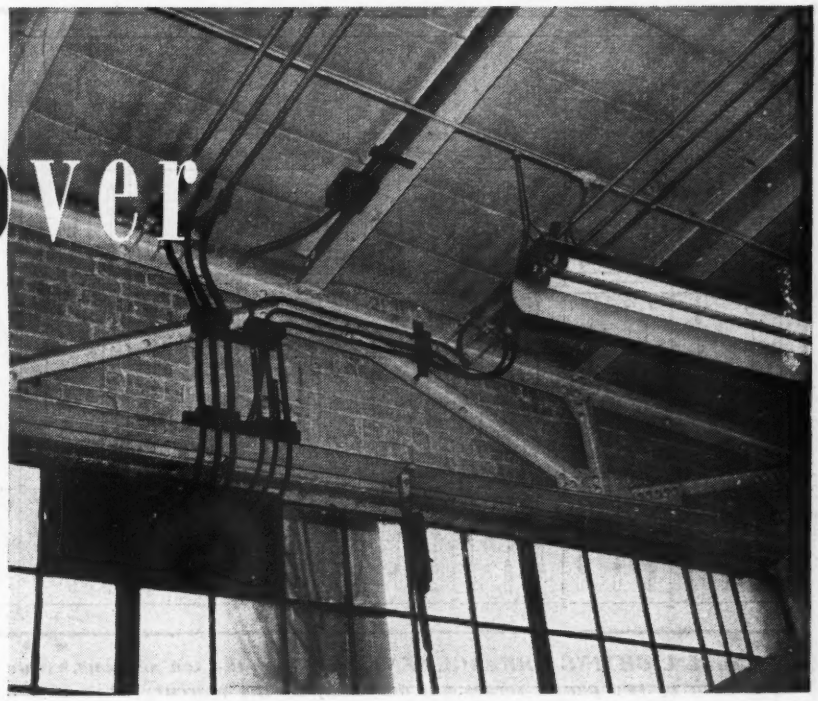
The gang-operated air disconnect switch rated 400 amps., 34.5 kv. was mounted atop the structure. Th 33,000 volt primary was then dropped to the lightning arrestors and on through the 30 amp. tong-operated outdoor fuses to the primary bus.

The transformer bank, which was delta-delta connected, was rated 600 kva., three phase, 60 cycle, 33 kv. to 460 volts, and consisted of three 200 kva. single phase units.

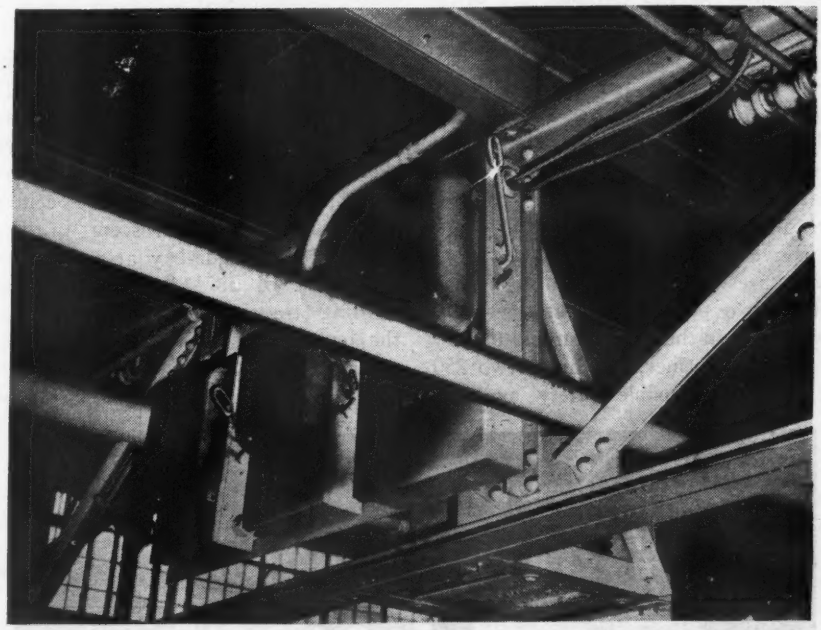
The substation is well grounded, being provided with a station ring ground bus of No. 1/0 stranded wire tied to six 10 foot Copperweld ¾-inch ground rods. The fence and all station equipment is connected to this ring of ground bus.

The drop to the enclosed switch and meter house is made with 750 MCM weatherproof cable in open air. Taps are taken off and the conductors pass through a weatherhead and conduit into the switchboard.

The power company metering equipment and the feeder volt, ampere and power factor meters are mounted on one section of the ebony asbestos panel.



***FEEDERS RUN** parallel in the trusses of the low side-bay area for the entire plant length.*

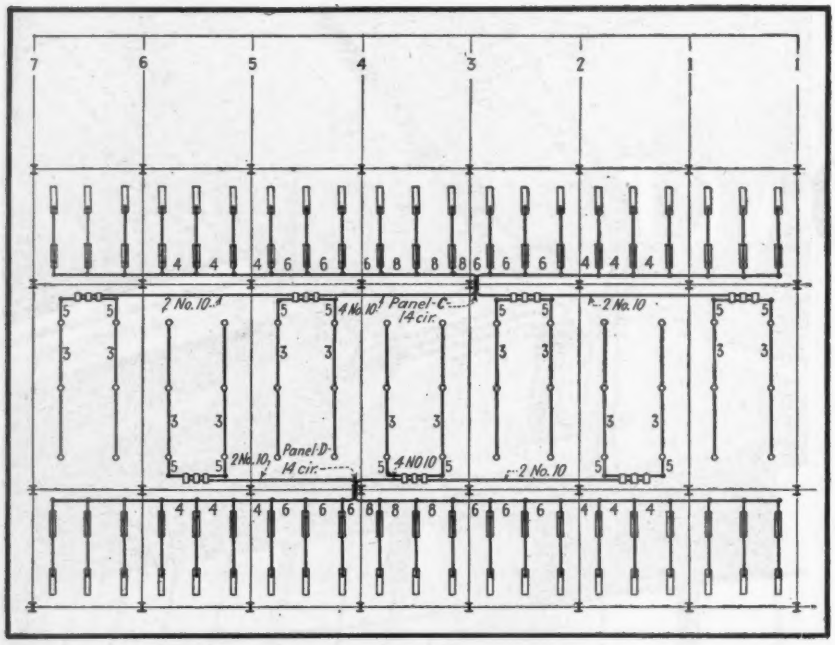


***LIGHTING LOAD CENTER** with 460/230 v. dry type transformer and safety switches mounted in the side-bay trusses. The two 250 v. switches serve two separate panels on opposite columns of the high bay area.*

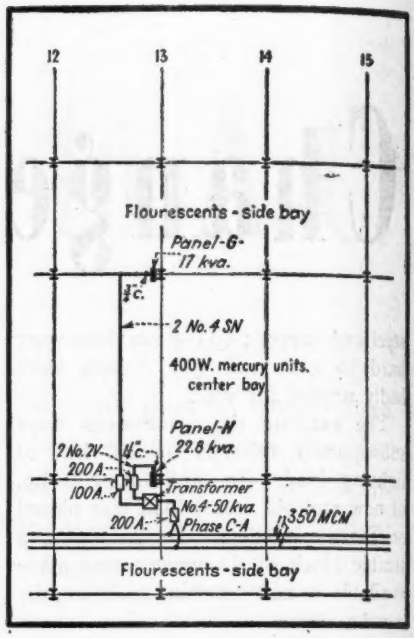
The other section of the panel is of the live front type on which are mounted the two feeder air circuit breakers. The breakers are rated 600 volt, three pole, and are provided with overload trips equipped with inverse-time-limit attachments. The 350 MCM lighting feeder is provided with a 500 ampere air circuit breaker while the No. 3/0 power feeder breaker is rated 400 amperes.

The two feeders emerge from the switch house in adjacent conduits into the open air. An accompanying photograph shows the cables rising in porcelain cleats on a steel lattice frame to the end of the main plant building. Three spool racks carry the feeders across the end of the building where they are taken inside through a window-opening plugged with insulating board.

Both power and lighting feeders continue open-wiring throughout the en-



***TYPICAL LIGHTING ARRANGEMENT** of one of the ten sections. Note that each of two panels serves not only half of the mercury units in the center high bay area but also all of the fluorescents in its respective side bay. All lighting circuits are 230 volts.*



***TYPICAL LAYOUT** of a lighting load-center. Note that transformer and switches are located in side-bay area, with panels on opposite columns.*

tire length of the building on three spool racks.

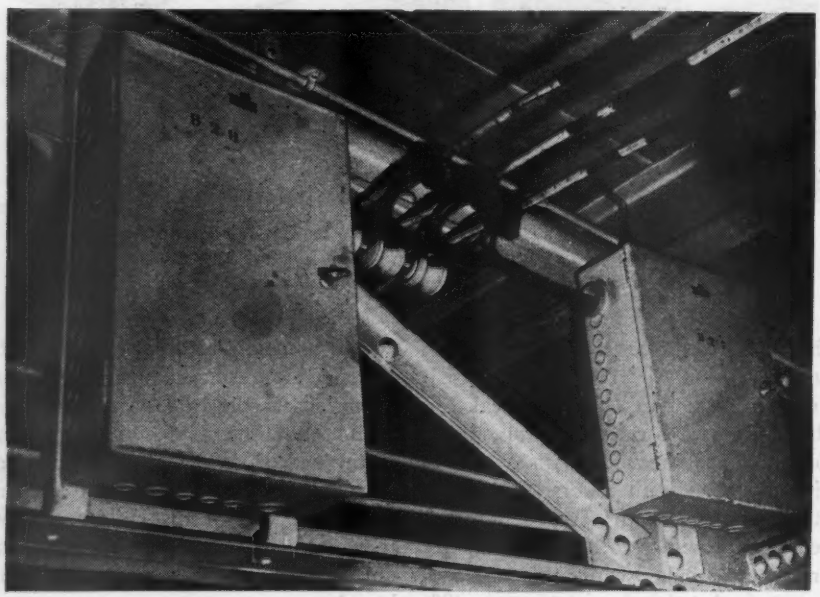
The entire plant lighting load has been divided into ten sections, each section focusing into a load center where 460/230 v. dry type transformers are located in the trusses to serve that particular area. Safety switches are also located up in the trusses to conserve space. Taps are taken from two phases of the 460 v. lighting feeder into a two pole 575 v. fusible safety switch (as in the accompanying photo) to the transformer, and on to two 250 v. two pole fusible safety switches which are mounted alongside the primary switch.

The 230 volt mains are then taken to their respective panels in EMT. Panels, which are located on opposite columns of the high bay area (see sketches) each serve half of the mercury high bay units in the center area and all of the fluorescents in their respective low side-bay areas.

A total of 387½ kva. of installed lighting transformer capacity serves the ten sections of plant area. Each section is served by either two or three panels with the load per panel varying from 15 kva. to 25 kva.

The high bay area is provided with 400 watt mercury high bay units installed 31 feet above the floor and located on 12 by 15 foot centers. Half-inch EMT is used for the distribution of branch circuits from the mercury transformers mounted on the crane girders. Conduit is clamped to the purlins, and at the fixture location is inserted a swivel ball hanger conduit fitting. Thin-walled conduit and threadless fittings are used for both carrying wires to the fixture and supporting it. To protect

[Continued on page 171]



***FUSE PANELS** for a.c. power circuits are likewise mounted in side-bay trusses. Taps enter the box through porcelain bushings and continue to safety switch at motor location.*

***THREE MERCURY UNIT** auto-transformers mounted side-by-side on the crane girders.*

Where to Use EMERGENCY INSULATIONS

Where and when can emergency and substitute insulated conductors be used? These composite tables developed by IAEI give the answers.

TABLE 1 . . . NEWLY RECOGNIZED CONDUCTOR INSULATIONS
(Revised to December 1, 1943)

Ungrounded (Live) Conductor

	EI[7]	SN	SBW	WP	V[2]	RU	AVA[2]	AVB[2]	SB	A
Open Wiring	x[1]	x	x[1]	x[5]	x[1]	x	x	x	x[1]	x[1]
Knob-and-Tube	—	x	—	—	x	x	x	x	—	—
Armored Cable	—	x	—	—	x	x	x	x	—	—
Non-metallic sheathed cable	x[1-3]	x	—	—	x	x	x	x	—	—
Service-entrance cable	—	x	—	—	x	x	—	—	—	—
*Conduit	—	x	—	—	x	x	x	x	—	—

Grounded (Neutral) Conductor

	EI[4-7]	SN	SBW[4]	WP[4]	V[2]	RU	AVA[2]	AVB[2]	SB	A	EG[6]	Uninsu-[9] lated
Open Wiring	x	x	x[1]	x	x[1]	x	x	x	x[1]	x[1]	x	—
Knob-and-Tube	x	x	x	x	x	x	x	x	—	—	x	—
Armored Cable	x	x	x	x	x	x	x	x	—	—	x	—
Non-metallic sheathed cable	x	x	x	x	x	x	x	x	—	—	x	x[8]
Service-entrance cable	x	x	x	x	x	x	—	—	—	—	x	x
*Conduit	x	x	x	x	x	x	x	x	—	—	x	—

NOTES:
*Conduit, including electrical metallic tubing, surface metal raceways, underfloor raceways, metal floor raceways, and wireways.
1. In dry locations only.
2. In dry locations unless lead covered.
3. For exposed work only.
4. On alternating-current systems only.
5. By special permission only.
6. Type EG refers to "other type specially approved for the purpose" in Interim Amendment No. 44.
7. Type EIL (lead-covered Type EI) may be used in wet locations covered by section 3033.
8. Non-metallic sheathed cable with an uninsulated grounded conductor is recognized in defense emergency buildings. See Interim Amendment No. 43 to section 3272.
9. An uninsulated grounded conductor may, under special conditions, be used on services.

TABLE 2 . . . CARRYING CAPACITIES OF CONDUCTORS

Size AWG MCM	Raceway or Cable: Types EI and SN	Raceway or Cable: Type V	Open Work: Types EI and SN	Open Work: Type V	1937* NEC
14	18	23	24	30	15
12	23	29	31	40	20
10	31	38	42	54	25
8	41	50	58	71	35
6	54	68	78	99	50
5	63	78	92	115	55
4	72	88	105	133	70
3	83	104	122	155	80
2	96	118	142	179	90
1	110	138	164	211	100
0	127	157	193	245	125
00	145	184	223	284	150
000	166	209	259	330	175
0000	193	237	298	383	225
250	213	272	338	427	250
300	238	299	373	480	275
350	260	325	421	529	300
400	281	361	457	575	325
500	319	405	517	660	400
600	353	453	577	738	450
700	385	488	632	813	500
750	398	502	655	846	525
800	410	514	680	879	550
900	434	556	728	941	600
1000	455	583	782	1001	650
1250	493	643	890	1131	750
1500	522	698	980	1261	850
1750	544	733	1070	1370	950
2000	558	774	1155	1472	1050

NOTES:
(*)—Type R wire not under continuous operation.
Carrying capacities based on interim amendments to NEC, December 1, 1943.

THE wartime need for conserving rubber has prompted the issuance of numerous interim amendments to the National Electrical Code permitting the use of emergency insulated and the substitution of rubberless insulated conductors for electrical distribution. Accompanying tables of carrying capacities of the conductors involved have also been issued. Despite their publication, among others, in a supplemental pamphlet form (requiring reference to the 1940 NEC) considerable confusion as to use limitation still exists in the minds of many electrical inspectors, contractors and plant electricians.

The extent of this confusion has been evident from the numerous requests for clarification that have been sent to the Chicago headquarters of the International Association of Electrical Inspectors. Realizing the need for some type of composite tabulation for quick reference, the IAEI has developed the two attendant tables which were distributed at the recent meeting of the Illinois Chapter, Western Section, IAEI, in Chicago.

Table I presents a quick overall picture of just where the various types of new and substitute insulated conductors can be employed. To clarify the designations somewhat the following conductor insulation legend is repeated:

[Continued on Page 170]

EDITORIALS

W. T. Stuart, *Editor*

Aircraft vs. Transmission Lines

Will overhead electric distribution with its array of sweeping conductors, insulators and poles or towers eventually disappear from along the highways? Technical progress in cable construction and economies in cable laying indicate that, though still expensive, the advantages of underground distribution will be more widely enjoyed postwar. But a very powerful new force will be felt that may give impetus to the job. Any considerable growth in civilian aviation will eventually affect the location and design of transmission lines. Aircraft and transmission lines are natural enemies. Each is a serious hazard to the other.

With a growth in civilian aviation will come a system of landing strips along our highways. Utility companies will be cooperating with civil aircraft authorities in clearing the air around landing fields and fueling stops. And new system design will eventually consider the aircraft element.

As a long range job, adapting electrical distribution lines to growing civil aviation will provide many new opportunities for electrical contractors who are properly equipped and staffed to handle such work for the utilities. It is a postwar prospect that promises to grow in importance in the years ahead.

For Longer Motor Leads

Among petty annoyances which tend to shorten tempers and add to labor cost are those neat little motor leads an inch or two long that have to be spliced out to make proper connections.

Short leads are hard to splice and difficult to tape. If lugs must be applied there is not enough room. They are almost always wasteful of labor. And the cure is so easy and cheap it is surprising that all manufacturers do not provide leads long enough to allow the mechanic to make connections or splices in any arrangement that fits the installation requirements.

A few extra inches of lead wire can make a large difference in installing and connecting time. Short leads are false economy.

Lighting Shipments Show Trends

Data recently released by WPB on shipment of electric lighting fixtures shows the total value for 1943 only slightly under 1939. The 1943 figures showed $15,099,000 worth of incandescent fixtures shipped and $20,113,000 of fluorescent or a total of $35,212,000 against the 1939 total of $35,328,000. Most of the 1939 total was incandescent.

This is a significant record considering the severe restrictions and regulations under which lighting is controlled from the manufacturing process to the final installation. It means essentially that the total of only the highly essential work permitted last year was practically equal in dollars to a good prewar year. And that is a pretty fair indication that the backed-up demand for modern lighting apparatus is relatively huge.

Serve Your Industry

The colossal problems of gearing this country to war took strong and experienced men from industry and labor. Most of the job was done well, some with extraordinary genius. Pretty soon all this must be dismantled and the rules affecting our economy lifted step by step. It will be a big job, exacting critical and requiring the best talent that can be brought to bear. And the job will have to be done at a time when men will be thinking of their own problems, of reorienting business toward peace time products and opportunities.

Agencies charged with the unwinding job after the war is won will be wanting help from men with specialized knowledge of industries and business. If you are asked to serve, do it. The more sound experience of men of top ability that goes into the task, the more intelligently it will be done.

School for Wiremen

Through the cooperation of Marquette University at Milwaukee, the I.B.E.W. will give chosen members from its ranks six weeks of intensive training in electronics. Groups of 80 to 85 journeymen will receive the course at one time and, on completion, carry their specialized skill and knowledge back to their own local unions.

The new plan for specialized training will inevitably bring benefit not only to the individual electrical workers who are fortunate enough to be chosen for the course, but to the craft at large and the industry of which it is a part.

It will be immediately effective in bringing trained men to the rapidly growing job of adapting electronic apparatus to new tasks in industry, commerce and the home. The application of electronic apparatus to fields other than sound and communication is threatened with over specialization. There has been too much talk of the complexity of electronic circuits and too little of the plain practical usefulness of electronic devices as auxiliary elements in conventional electrical circuits. Skilled wiremen with training in electronics will prevent this useful new apparatus from becoming isolated as a technical specialty.

The new training program is significant also as an indication of a long range trend. The Brotherhood is tak-

ing a forward step toward a policy of continued education for its members. As the technology of the electrical industry grows the responsibility for bringing individual skills and know-how up-to-date is great. Although the Marquette course is entirely practical and geared directly to present needs, future historians of the labor movement will probably find in it an important milestone along the road of labor's progress.

How to Terminate

War Department Pamphlet No. 34–2 is a contractor's guide in preparing for and carrying out contract termination. In graphic style and uncomplicated by too much detail, it tells precisely and easily what to do and what not to do. It should be in the hands of every contractor or subcontractor who faces possible contract terminations in the coming months. It is available from the War Department.

Confidence Is Basic In Labor Relations

The L. & P. Electric Company, Brooklyn, electrical contractors, celebrated its 25th anniversary last month. Though a quarter century of service is well worth noting, there is certainly nothing unusual about making it the occasion for a dinner and appropriate speeches. This occasion, however, was different and deserves comment; the employees were the hosts and the employers the honored guests.

And underneath the festivities and courtesies of the affair it was plainly evident that the employees recognized and honored their bosses for building and maintaining the organization which created steady jobs and good working conditions over a generation. They know that payrolls don't grow on trees. They know that the jobs were created by initiative and skill and commercial daring of able men.

Labor relations have become so involved with legal contracts, government agencies and complex negotiations that fundamentals are often lost. And a clear understanding and appreciation at the human level of the burdens and responsibilities of manager or employee is so elementary that we sometimes forget it in trying to make those relations into impersonal rules. Actually collective bargaining, working rules and wage agreements are only a part of the whole job of labor relations. The vital element of mutual understanding and confidence cannot be written into a contract.

And when we find such mutual understanding and respect it is worth noting because it is only in such an environment that strong and confident labor relations can thrive.

Distribution Is An Essential Function

So much has been said about cost reductions at the manufacturing level contrasted with the high cost of distribution in discussions of the postwar economy that it is about time for business men to speak up in defense of the distribution function.

The process of moving a product from the manufacturing line to its eventual use in the hands of the consumer is in no way subordinate to the manufacturing process. In the course, there are important services performed beyond transportation. Products are warehoused, stocked, packaged or grouped with related materials, selected, fitted, sold and serviced.

But, probably most important of all, the distribution system gives the customer's order access to the manufacturer upstream as well as providing a channel for the manufacturer to reach the user with his product.

It is customary to think of distribution as following manufacturing. That is a serious fallacy. The sale, an elementary and essential part of distribution, must come first. Practically, we anticipate sales, but functionally the economic process starts with the sale, then the order running upstream, then the manufacturing and the distribution of the product to the user.

The distribution process is a two way road. It must be considered in the light of a circuit for orders as well as a track for delivery. The highly critical point is at the contact with the customer. That should be constantly strengthened. And in the distribution of electrical materials, the contractor is the customer contact.

Washington Notes

► Successful and methodical progress of the invasion is tempered by considerable pessimism on some war production programs; heavy artillery and trucks are still behind schedules and hoped-for easing in some materials has not been forthcoming. The Nelson 4-point plan that encountered objections from the armed services and other top men offered little for reconversion that was not already available. However, as a gesture toward reviving civilian production it coincided with new manpower controls on July 1 and the two seemed incompatible and confusing to the public.

► Actually WPB men have to be realistic. Allocations of materials and men are taken from limited supplies of both. Permission to begin civilian production drains labor out of a seriously short supply. And at the root of most of the apparent hesitation of WPB to give the green light to some civilian projects is the problem of potential manpower.

► OPA regulations will be tapered off as rapidly as possible when the shooting stops. Consumer goods will be the first to be removed and capital goods regulation shortly thereafter. OPA executives are particularly anxious to have close contact with top shelf men in industry for the difficult unwinding.

► Selective service is easing off on its calls but will continue to take men from the 26-year old and under group. Some boards are finding difficulty keeping the age average down where the services want it. The reason is voluntary inductions of men over 30 under the stimulus of the G.I. bill and its postwar implications.

► Hopes for many civilian products are still far off. Even though men might become available, and manufacturing facilities at hand, there is no way to allot such items as forgings, castings, some categories of steel, antifriction bearings and the woefully short fractional horsepower motor. Any major reduction in war programs, however, could change the picture overnight.

► The Smaller War Plants Corporation is selling WPB on strong consideration for smaller companies in the Nelson plan to authorize reconversion on August 15th. S.W.P.C. is concerned that large plants may be favored and is continuing its aggressive campaign of champion to small business.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

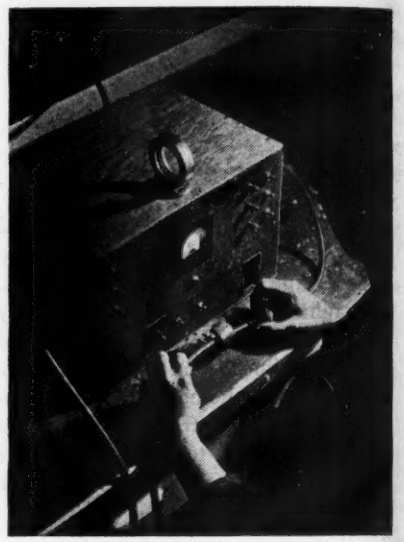
PRACTICAL METHODS

ELECTRONIC CORD TESTER FOR LOCATING CONDUCTOR BREAKS

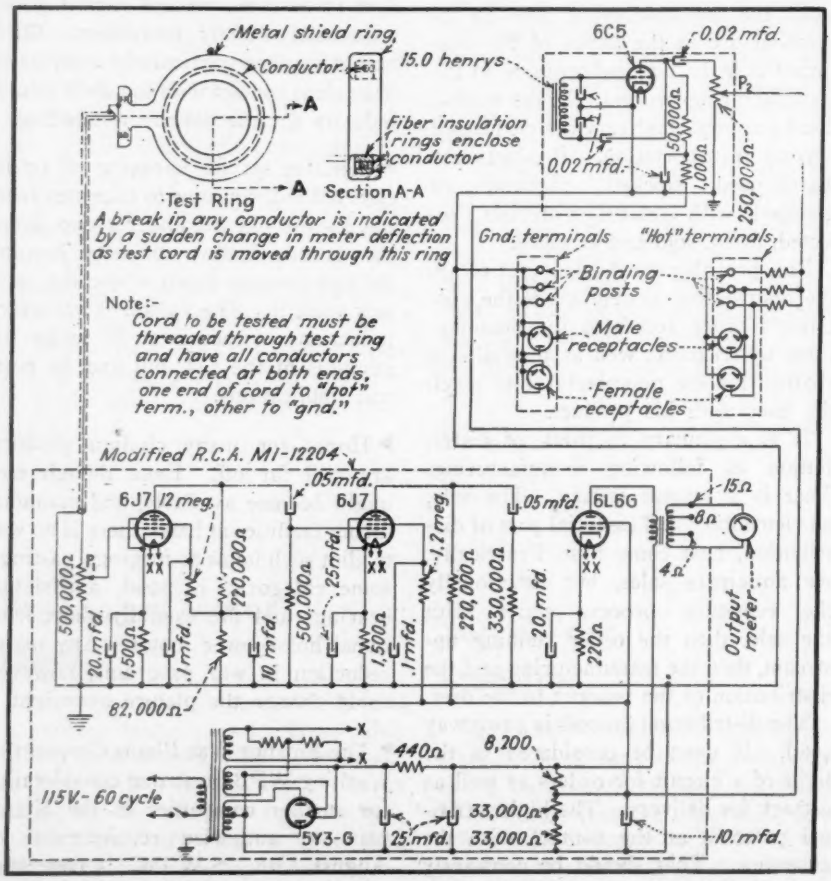
MAINTENANCE

Electric cord salvage is an important item to the electrical maintenance department of the Consolidated Vultee Aircraft Corporation plant at Fort Worth, Texas. With approximately 10,000 portable electric drills in use and thousands of hand lamps and other electric tools, there is probably upward of 50 miles of three-conductor, heavy duty electric cord used for extensions throughout the plant. When, through twisting or turning or tension, the conductor of a cord is broken the extension is not idly discarded. It is carefully checked and, after the break has been located, as much of the cord as possible is salvaged for re-use.

To expedite quick and accurate location of hidden conductor breaks, an electronic testing device was developed by Consolidated Vultee's electrical maintenance department. The heart of the test device is a three-stage amplifier (Modified R.C.A. M1-12204) to which is coupled an output meter, and an oscillator to impress a signal voltage (in the order of 400 to 500 cycles) on the cord to be tested. A single-conductor loop, enclosed in a metal shield ring, is connected to the amplifier circuit, as well as an insulated open hook attachment (see photo) for use with cords having large plugs and receptacles that will not pass through the ring.



ELECTRONIC CORD TESTER has facilitated the salvage and re-use of thousands of feet of electrical cord for tool and hand light extensions at the Fort Worth plant of the Consolidated Vultee Aircraft Corporation.


Metal shield ring
Conductor
15.0 henrys
6C5
.02 mfd.
A
Fiber insulation rings enclose conductor
Test Ring
Section A-A
A break in any conductor is indicated by a sudden change in meter deflection as test cord is moved through this ring
Note:- Cord to be tested must be threaded through test ring and have all conductors connected at both ends, one end of cord to "hot" term., other to "gnd."
Gnd. terminals
"Hot" terminals
Binding posts
Male receptacles
Female receptacles
Modified R.C.A. M1-12204
6J7
6L6G
Output meter
115V.- 60 cycle
5Y3-G

WIRING DIAGRAM of the cord test device showing the application of the amplifier and oscillator circuits used in locating hidden breaks in the cord conductors.

To the oscillator circuit are connected two groups of terminals (binding posts and receptacles) to which the cord under test is connected—after being passed through the test ring or hook. The "hot" set of terminals is fed through high resistance units, from the potentiometer "P2" side of the oscillator circuit. The "ground" set of terminals, with all contacts of the binding posts and receptacles tied together, is connected to the ground side of the oscillator circuit. The two potentiometers—"P1" in the amplifier circuit, and "P2" in the oscillator circuit—can be adjusted for any type of cord to keep the meter deflection on the scale.

To operate the unit, the potentiometers are first set at predetermined points for the type of cord being tested. The cord is then plugged into the "ground" receptacle (or connected to the ground terminal binding posts); the free end is threaded through the test ring (or the open hook) and plugged into the opposite "hot" receptacle. Then, starting at the "ground" end the cord is slowly passed through the test ring (or hook) while the operator keeps her eyes on the meter.

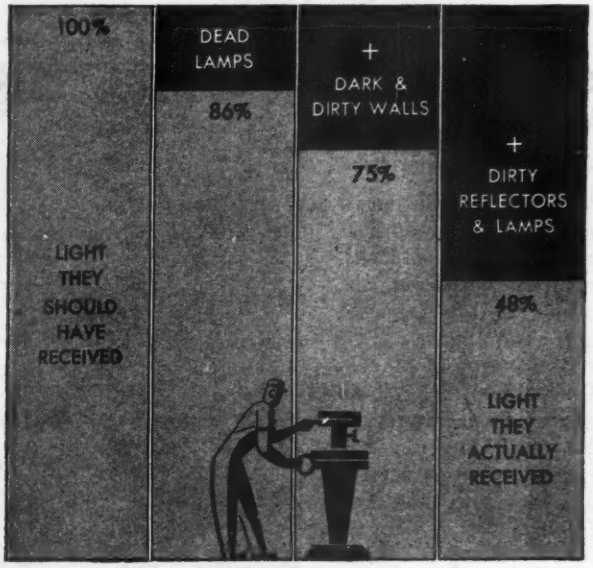
Fluorescent operating hints

No. 3 of a series published by SYLVANIA for all users of fluorescent lighting

HOW TO GET THE LIGHT YOU PAY FOR

Observing a few simple operating rules can prevent waste of as much as 50 per cent of the fluorescent light you buy.

For example, here is the waste caused by improper maintenance in one typical plant:



Dead lamps left in fixtures rob this plant of 14% of the light that is being paid for—dark and dirty walls, of 11% more—dirty reflectors and lamps, of 27% more. Why get only half of the light that simple maintenance will bring you?

SCHEDULING MAINTENANCE SAVES DOLLARS IN LIGHT

Schedule regular checking and cleaning. All you need is a lightmeter.

Whenever the meter shows that you are receiving 25% less light than you should—it's time to check for dead lamps, and to get out the soap and water.

Attend to dead lamps first. Unless they are cut out of the circuit, they tend to overheat ballasts, wear out your starters, and waste electricity. But before you discard lamps, be sure the fault is not in the starters, ballasts, or circuit.

"TWO-MAN TEAM" MAINTENANCE METHOD

All you need to insure clean lamps and reflectors is plenty of soap and water—plus a *regular* maintenance schedule. The following two-man method has been proved very successful.

1. Two-man team begins work with one clean reflector previously removed from a fixture near the end of the cleaning route.

2. At first fixture on the route, man on ladder removes lamps and reflector, hands them down to man on floor in exchange for previously cleaned reflector. Ladder man then cleans housing, side panels, etc.

3. Ladder man secures clean reflector in place. (No hand tools are required with Captive Latches on Sylvania Industrial Fixtures). Man on floor wipes off the lamps and passes them back to ladder man.

4. Ladder man, with supply of Sylvania Starters, reinstalls cleaned lamps and sees that fixture is working properly.

5. Ladder man descends and puts ladder in place at next fixture. Meanwhile, man on floor washes and dries the first fixture and has it ready to replace soiled reflector in the next fixture.

Follow this procedure through entire installation.

HOW OFTEN?

Frequency of cleaning depends upon the location of installation and the type of work it lights. Air-filtered and air-conditioned rooms may require fixture cleaning only once in six months. But cleaning may be necessary every few weeks in a factory where the atmosphere is heavy with dust and oil. Be guided by your lightmeter in scheduling cleaning.

For Additional Maintenance Information

Send for this Free Booklet—

100,000 already distributed

SYLVANIA ELECTRIC PRODUCTS INC.

"Fluorescent at its Finest"

SALEM, MASSACHUSETTS

FLUORESCENT LAMPS, FIXTURES AND ACCESSORIES, INCANDESCENT LAMPS, RADIO TUBES, CATHODE RAY TUBES, ELECTRONIC DEVICES

Through this test ring or hook, the amplifier picks up the signal from the voltage impressed on the cord by the oscillator. When the ungrounded side of a conductor break passes through the ring, the meter will give an indication. No indication is given when the grounded side of the break passes through since no voltage appears between the broken conductor and other conductors at this point. Thus the need for passing the cord through the ring from the grounded to the ungrounded side and the necessity of having all conductors connected at both ends.

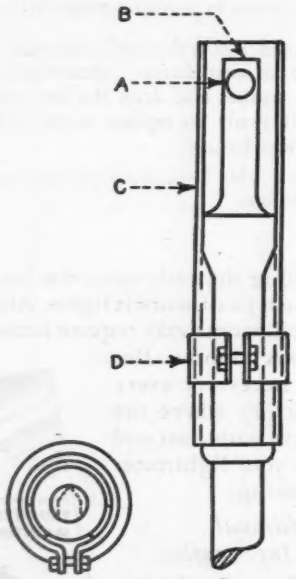
When the break is definitely located, the cord is cut at this point and the two pieces re-made into extensions or used for cord replacements on tools or hand lights.

STATIONARY IRON SIMPLIFIES SOLDERING

INDUSTRIAL

The job of soldering small wire connections is simplified at the General Electric plant in Schenectady by making the iron stationary and dipping the connections into a small hole filled with solder near the tip of the iron.

As shown by the drawing, the soldering iron can be fixed for use in this manner by drilling a hole (A) into the tip (B). A nickel steel tip will last longer than other types.



SMALL HOLE in tip of soldering iron forms a well of hot solder into which connections can be dipped.

The drip and splash guard (C) catches surplus or drips of solder coming off the iron. It is made of 1/32-inch steel and is fastened to the iron with a hose clamp (D).

BATTERY TRUCK is used to wheel the Crow's-nest around through the Sperry plant to maintain lighting equipment. The inclined ladder permits maintenance men to get above closely spaced machinery from the aisles.

FAN REMOVES WELDING FUMES

INDUSTRIAL

Where welding is done in small enclosed areas and where other workers must also carry on their assigned tasks, smoke and fumes from the welding arc should be removed from the restricted area by one means or another.

In the motor repair shop of Marvin M. Gleason, Binghamton, N. Y., an efficient and inexpensive arrangement for the expulsion of welding fumes to the outside air has been designed and built by Gleason's ingenious shop foreman Carlton Tanner.

Since most of the welding is done in a work-bench vice, a sheet-metal canopy or hood has been mounted over this area as can be seen in the accompanying photograph. An angle iron frame supports a fan up in the vertex of the canopy to draw the smoke and fumes into the fan blades and out a vent to the outside air.

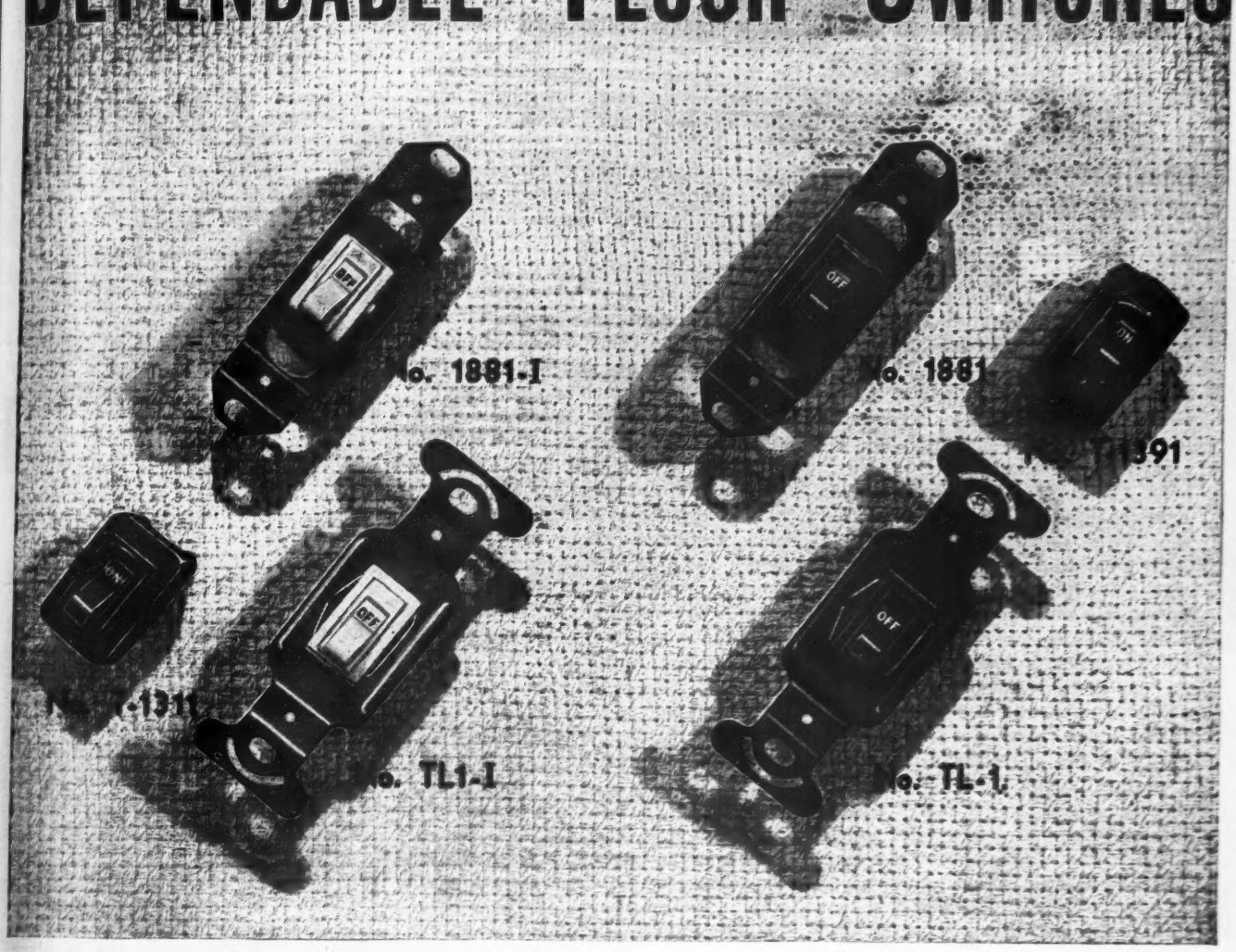
The fan is a double end shaft squirrel cage motor with a blower assembly on each end. The unit is one that had been removed from an old air conditioning unit.

Since the canopy necessarily extends over quite an area cutting off the overhead light, a lamp has been mounted within to provide sufficient illumination for bench work in setting-up prior to welding. Two snap switches are provided at the corner of the canopy within easy reach of the welder. One is for the canopy lights; the other controls the blower circuit breaker.

SHEET METAL CANOPY and blower expels welding smoke and fumes. Carbon arc is used to weld end ring to rotor bars. Note piece of pipe used to protect bearing surface from spattering metal particles.

Most of the welding done is of a repair and maintenance nature. A 300 ampere Emerson transformer welder is used. One important job the unit does is the welding of end rings on squirrel cage rotors. Very often end rings are soldered to the copper rotor bars and under overload conditions enough heat may be generated to loosen the soldered connections. To make sure they never come loose again, they are welded with a carbon arc which flows the coppers together in a good strong joint.

DEPENDABLE FLUSH SWITCHES



ARROW Standard and Interchangeable Lines

These popular numbers provide essential types for "coming through" on residential wiring requirements. Both the Standard and Interchangeable Line switches have the same degree of dependable design and mechanism — the ARROW "degree".

Numbers illustrated above include representatives of the "TL" Line:- single-pole, double-pole, 3-way and 4-way — residential type. Also, Interchangeable Switches to go with receptacles or other units in a single gang.

ARROW ELECTRIC DIVISION

DISTRIBUTED THROUGH ELECTRICAL WHOLESALERS

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U.S.A.

The welding equipment has a great number of other uses in repair, such as building up contacts and shafts, and repairing cracked frames and end housings.

CIRCUIT TESTING IN MARTIN BOMBERS

TESTING

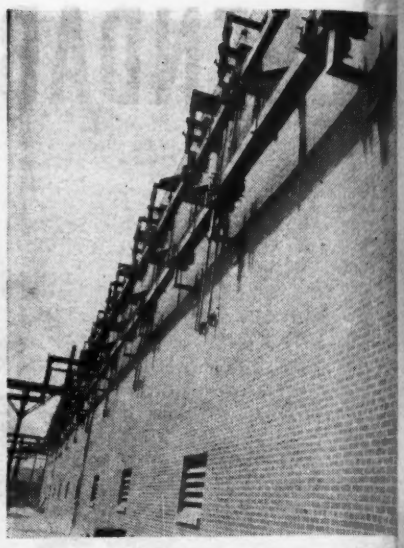
As automatic control and electrical developments in aircraft design has progressed, the great mass of wiring in bomber planes has become greater. And in such critical wiring work, circuit testing is of major importance to insure proper operation of the many, many circuits, switches, horns, bells, buzzers, telephones, motors, lights and other elements of bomber accessories, signal and power systems.

Original tests in the early days of war plane production, when bomber wiring was much more simplified than now, consisted only of ground and bonding tests, a few continuity tests and no checks whatsoever on the installed equipment. And yet this relatively simple inspection required the efforts of two electrical inspectors for a total of 16 manhours for one bomber. In the Glenn L. Martin Company plant at Baltimore, Maryland, a testing technique has been developed which will now completely check in two hours the entire electrical systems and accessories of the newer bombers that roll from the assembly lines and which contain much more complicated wiring than heretofore.

For instance, on the B-26, tests now include checking continuity of all wires in the interphone system and proper connections in every interphone box; checking continuity on every wire, switch and light in the interior lighting system, lighting all lights if necessary; testing and operating all bells and horns; and testing all door switches.

More specialized tests include making continuity tests of every switch including the propeller control circuits on the engine control pedestal panel; completely testing the bomber's switch panel, operating each and every signal light both separately and in salvo, and checking rack selector switches for proper connection and operation; testing the autosyn and liquidometer systems and the gun firing and gun circuits; testing and operating windshield wiper motors; testing landing gear positions and locking switches, and testing and running all anti-icer, deicer, fuel transfer and booster pumps, among other equipment.

Every main wire that runs to a switch or some piece of electrical equipment is tested by the use of cable runs connected to a test set, and other ends having Cannon plugs or terminals to connect to the plugs or terminals in the section. Wires that cannot be tested in this manner are tested on a separate circuit using a point to point continuity test using lights and buzzers in the circuit. The bomb system and the auxiliary boxes on all bomb racks are tested and operated from the bomber's circuit plug by an adapter circuit that works into the bomber's circuit in the test set.



THE SILVER BUS which runs the length of the rectifier buildings at Alcoa's New York City plant is hung outside and is telescoped. Note that the number of bars in the lower run reduces each time a tap is taken off to a bank of rectifiers inside.

This new testing technique is the result of development of a circuit analyzer designed by four of Martin's electrical inspectors.

The analyzer is a compact portable unit (as can be seen in the accompanying photograph) containing equipment for testing every wire and piece of electrical equipment in the airplane, yet flexible enough to permit modification when needed to meet engineering changes. Since operation of the unit consists solely of plugging into the various circuits of the airplane, its use permits a woman with no experience to perform tests formerly requiring an experienced electrical inspector, and achieve perfect results in a fraction of the time previously required.

The use of the device is not confined to manufacturer's inspection, and the same units can be used by service mechanics on the flight line to locate and isolate troubles.

The B-26 circuit analyzer is designed to actively test the wiring of the airplane, section by section at a low voltage (4v.) for continuity before the fuselage is spliced. And in addition to the many tests listed above it is also designed to test and operate all operational units and the lighting systems at their required voltage. The check so supplied is precise and accurate and has provided a safe, sure method of testing electrical circuits in which both fire hazards and the possibility of error are completely eliminated.

THIS PORTABLE UNIT developed by four members of the Glenn L. Martin Inspection Department, and known as the circuit analyzer, is equipped to actively test every wire, and test and operate every piece of electrical equipment on the B-26 Marauder. The inventors are left to right: J. D. McCallister, H. R. Morawe, W. A. Matson and J. M. Aldrich, Jr.

ON AND OFF 1,034,827 TIMES ...STILL RUNNING PERFECTLY

Thor

"Armored in Plastic" ELECTRIC DRILL

Every Original Revolving Part Still Functioning Smoothly After 18 Months

For over 18 months—every consecutive working day since December 17, 1942, a Thor "Armored in Plastic" Portable Electric Drill has been automatically starting and stopping while an indicator counts each completed cycle.

This testing of the action of centrifugal force and accelerations on all parts *still carries on* after completing 1,034,827 cycles to amass more and more convincing proof of the durability of these Thor plastic-housed production and maintenance drills.

Already proved—even if the test were to stop today—is the *durability* of Thor motors, gears, bearings and other parts of the unit! *Newly proved* is the durability, greater protection and perfect alignment provided by the inner metal frame which holds the operating parts without assistance from the drill's plastic housings!

Laboratory view of the Thor "Armored in Plastic" Electric Drill mounted on the apparatus performing the durability test.

LABORATORY TEST ORDER
Independent Pneumatic Tool Co.

Test Item: U14K Plastic Drill

Dec. 17, 1942

Problem: Durability under repeated reversal of stress. Determine number of times the drill may be started and stopped before failure of any part occurs. (Brushes excepted.) Note carefully the effect of centrifugal force on motor parts and wear due to accelerations and reversal of stress on all parts.

Method: Continue test until first breakdown occurs.

Arrange apparatus for automatic on and off switching. Each time the drill is turned on it must come up to full speed. Each time the drill is shut off it must stop completely. Full running speed and complete stops must be attained to produce the maximum centrifugal stress in motor windings in both the outward and inward directions. The inrush of starting current should be maximum to secure severest test of windings and utmost stress due to accelerations.

DAILY LABORATORY TEST REPORT

June 15, 1944

Item: U14K Plastic Drill.

Problem: Durability under repeated reversal of stress.

Progress: 1,034,827 on-and-off cycles completed. Each original unit part - armature, commutator, stator, gears, bearings, still intact and running perfectly.

Total Maintenance: Second set of brushes replaced; standard lubrication.

Conclusion: Test continues.

R. Rebeccini
Test Engineer

For complete information an specifications of all types ar models of Thor Portable Electr production and maintenance too write today for Thor Catalog 3

This same Thor motor, packing more power per pound of machine than is common . . . providing these same features of durability and top performance, is the heart of every Thor Portable Electric Tool.

- DRILLS
- HAMMERS
- SCREWDRIVERS
- SAWS
- NUT SETTERS
- GRINDERS

Thor Portable Pneumatic and Electric Tools

INDEPENDENT PNEUMATIC TOOL COMPANY

600 W. JACKSON BOULEVARD, CHICAGO 6, ILL.

Branches in Principal Cities

Answered by
F. N. M. SQUIRES and GLENN ROWELL
Chief Inspector
New York Board of Fire Underwriters
New York, N. Y.
Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

QUESTIONS ON THE CODE

CONCEALED CEILING OUTLET

Q. *"A 'Practical Methods' item in the June issue described a use for an abandoned three way switch circuit. The item mentioned making connections in the ceiling outlet 'before it was plastered over.' May outlets no longer used for fixtures but still containing connected wiring be concealed in this manner?"*—S.W.

A. The article mentioned indicated that in ceiling outlets eliminated during redecoration, the connections could be shorted, the switch leg used to feed a receptacle and the outlet cover plastered over. Undoubtedly this has been done many times but it is considered a code violation as the outlet is concealed and not readily accessible. Outlet box covers should always be visible and readily accessible.

Some inspection departments will give special permission for concealing such boxes provided that an indication of the location is left on the finished surface.

With concealed knob and tube wiring, however, boxes are not required at splice or junction points (see Section 3014) and with this type of wiring the splice could be backed up into the ceiling and the hole closed.—F.N.M.S.

USE OF METAL PLATES

Q. *"In the using of metal convenience outlet plates that are attached to bakelite switch type boxes, using non-metallic uninsulated neutral cable, wood floor construction, no outlets in toilets or bath rooms, or in close contact with any plumbing or pipes, my opinion is that it is not necessary to ground the plate. Am I right?"*—J.K.

A. The question here is not about the grounding of metal switch and receptable plates, but is about the use of such metal plates. Interim amendment No. 43 forbids the use of metal plates with "non-metallic sheathed cable having one circuit conductor without individual insulation, etc." The last sentence of Section 3372 (of Amendment No. 43) reads: "Junction boxes, outlet boxes, covers and *switch receptacle plates* on branch circuits *shall be* non-conducting material approved for the purpose." Therefore metal plates are taboo.—F.N.M.S.

GROUNDING NEUTRAL

Q. *"During last January I wired several farm homes on the R.E.A. lines and grounded the neutral at the services by driving an eight foot approved rod through the basement floor. The ground outside was frozen to a depth of five feet, making it almost impossible to drive the rods outside, and furthermore, the rods driven through the basement floors extend at least five feet deeper into the earth than they would have had they been placed outdoors, yet the inspector refused to O.K. these jobs until the grounds had been placed outside. Can you explain the reason for such a ruling?"*—H.R.

NEW OFFICERS of the Minnesota Electrical Inspectors Association are (L. to R.) president, Martin Streed, Minneapolis, and secretary-treasurer, Glenn Rowell, Minneapolis. Robert Kaping, Litchfield (not present) is vice-president.

A. To be effective, a driven ground rod must reach permanent moisture and you will find the soil beneath the average building exceedingly dry unless it so happens that the building in question is located on low ground where the water table reaches within a few feet of the basement floor. In your territory the soil is sandy and well drained and the permanent water table is many feet below the average basement floor, so it is unlikely that an eight foot rod would ever reach moist earth when driven through the basement floor of a building. Minimum requirements of the National Electrical Code specify that the resistance to earth of a neutral ground shall not be more than 25 ohms. Actual tests made following prolonged dry spells on driven eight foot rods in well drained sandy soil have shown resistances much in excess of 25 ohms. In fact, the utilities have been forced to the use of grounding counterpoise in certain well drained sandy soils in order to assure adequate ground on their primary. Actual tests, witnessed by the writer, on ten foot driven rods near St. Croix Falls, Wisconsin, indicated that it was impracticable to attempt the grounding of the neutral by means of driven grounds even though they were well salted.

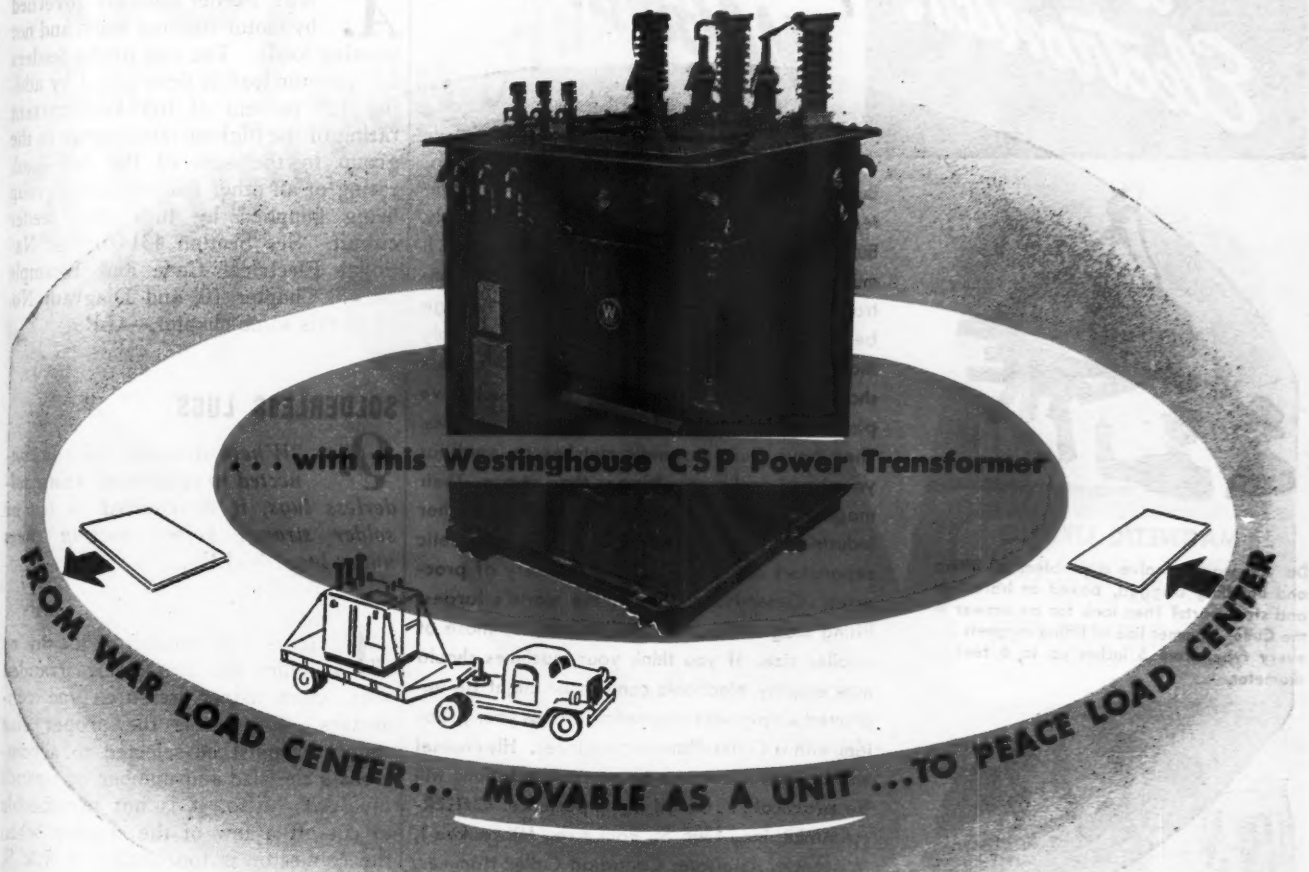
Usually when grounding the neutral of a farm building wiring installation, it is possible to choose a place for the ground rod where the ground is the least likely to dry out and where the run-off from the roof will supply additional moisture. Such a location would usually be on the north side of a building and well away from shrubbery or tree roots which might draw the moisture from the ground.—G.R.

ADDITIONAL MOTOR LOAD

Q. *"A three-phase feeder consisting of No. 0, Type R, conductors has supplied a 100 ampere motor load and I have been asked to install a bank of condensers in series with the*

WHEN PEACE COMES...

RECONVERSION IN HOURS



In a matter of hours, a CSP power transformer can be moved to a new load center. When the day of reconversion comes—just disconnect, roll onto a trailer-truck, take to a new platform, and reconnect.

Westinghouse CSP Power Transformers contain in *ONE UNIT*...

• transformer	protection against
• circuit breaker	—lightning
• voltage regulator	—overloads
• metering	—short circuits

Compare this with the time required to move a conventional single-feeder substation . . . with its 43 major components. The Westinghouse CSP power transformer makes reconversion easy and *economical.* It saves man-hours . . . permits practically 100% salvage of the war-load installation.

The Westinghouse CSP power transformer performs *all* the functions of a conventional single-feeder substation. It is completely self-protecting (CSP) against lightning, overload and short-circuit damage. For complete information, call your Westinghouse office or write Westinghouse Electric & Manufacturing Company, Dept. 7-N, East Pittsburgh, Pa. J-70439

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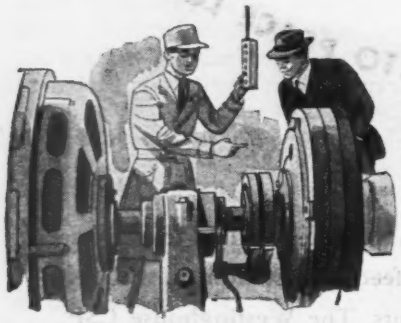
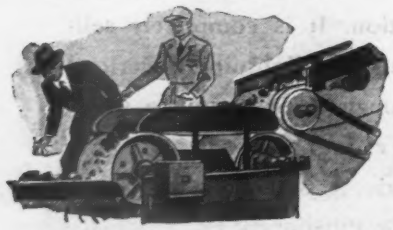
Do you want to solve a problem of lifting and handling bagged, boxed or bare iron and steel parts? Then look for an answer in the Cutler Hammer line of lifting magnets . . . every type, from 5 inches up to 6 feet in diameter.



MAGNETIC CLUTCHING

To start and stop machines smoothly, automatically, investigate C-H Magnetic Clutches. All mechanical clutch functions plus many extra advantages. Remote control by push-button or automatic means. Superior where speed relationship is fixed or space at a premium.



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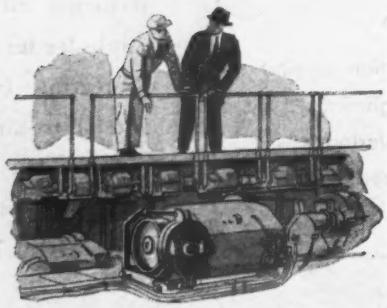
To keep materials in process free . . . to protect valuable machinery . . . from stray pieces of iron or steel, use a Cutler-Hammer Magnetic Separator. Can be installed as part of continuous conveyor line. Valuable in salvaging scrap from refuse, etc.

Builders of all kinds of machines are deeply interested in the possibilities of *electronic* controls. But before any machine may use electronics, it must be *electrically* operated to make such control possible. Magnetics can be the bridge between mechanics and electronics. Possibly that is the very point where your redesign work should start. Cutler-Hammer engineers have pioneered in both magnetics and electronics. They have built magnetic clutches as small as your hand and others bigger than a man. Their magnetic brakes are used in steel mills and other industries throughout the world. C-H magnetic separators are used in a wide variety of processes. Cutler-Hammer built the world's largest lifting magnets . . . and the majority of those of smaller size. If you think your machines should now employ electronic controls or might be improved simply with magnetics, discuss your problem with a Cutler-Hammer engineer. His counsel will be useful because his recommendations will be practical . . . based on experience. CUTLER-HAMMER, Inc., 1306 St. Paul Ave., Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ont.

Engineering Excellence Finds its Greatest Reward in the Respect and Confidence of those it Serves.

CUTLER-HAMMER
MOTOR CONTROL
C-H



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Where machines must be stopped, automatically, quickly, without a jar, use a C-H Magnetic Brake. Pushbutton or automatic control. Action smoothly cushioned, operation positive and assured. For hoists and cranes or wherever loads are to be held or machines stopped.

feeder and add an additional motor load of 50 amperes to it. All motors supplied by this feeder might be operated at the same time. Would the National Electrical Code standards permit such an installation?"—B.E.

A. No! Feeder sizes are governed by motor running loads and not starting loads. The size of the feeders for a motor load is determined by adding 125 percent of full load current rating of the highest rated motor in the group to the sum of the full load rating of all other motors in the group being supplied by the same feeder circuit. See Section 4314 of the National Electrical Code and Example No. 5, Chapter 10, and Diagram No. 15 of this same chapter.—G.R.

SOLDERLESS LUGS

Q. *"Where stranded cable is connected to equipment using solderless lugs, is it required to tin or solder strands before putting them under lugs?"*—J.K.

A. It is not necessary to tin or solder the strands of stranded wire when using pressure type connectors. Of course the proper size connector must be selected to accommodate the size and number of strands involved. Also, it is not permissible to cut off a few of the strands when the connector is too small.—F.N.M.S.

GROUNDING TRANSFORMER

Q. *"In a warehouse I have a main switch and eight sub-feeder switches which feed eight 6-circuit lighting panels. The service is in conduit 3-in. with three 350,000 CM cables. I grounded the switch with No. 4 wire; the sub-feeds to panel is open type construction supported on insulators, the circuits from panel are in non-metallic uninsulated neutral cable. There being no water nearby, I grounded the metal box with grounding screw through neutral strip, (cement floor construction four ft. above grade). I drove a ground rod at transformer pole to ground the neutral at transformer, but in testing ground found it to be very high resistance only about 50 volts to ground. I believe that the using of the neutral is sufficient ground."*—J.K.

A. Using the neutral as a ground is certainly not sufficient. While it is apparently permissible to bond the neutral to the metal cabinet of the panel, in this case the grounding con-

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In the New RED PLASTIC Can

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Submitted to Electrical Testing Laboratories, Inc., for certification.

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NEW AND DIFFERENT. The most effective starter yet produced.
Outstanding contribution to effective operation of fluorescent lamps.

1. Positively cuts out deactivated, flickering, blinking lamps.
2. When trouble is detected the starter automatically cuts off current to the ballast and lamp.
3. Gives long life to ballast because defective lamp is locked out. Prevents overheating.
4. When Lloyd AUTOMATIC locks out defective lamp —turn off the current—Remove defective lamp—Put in a new lamp.

   Allow at least one minute to make the above change of lamps. Turn on current. The starter automatically lights the new lamp.

   NO NEED TO DO ANYTHING TO THE STARTER
5. Lloyd NEW PLASTIC CAN has higher dielectric strength, is stronger, lighter, distinctive.
6. Knurled rim on plastic can insures positive grip for insertion and removal of starter.
7. Plastic can is sealed. No projecting lugs to cause trouble.
8. The life of the AUTOMATIC starter is many times greater than that of the average lamp.
9. It saves maintenance costs and power consumption, protects and insures longer life to the ballast and lamp.
10. Tested in production and prior to shipments to insure perfect performance.

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Get more light on this subject ...see page 21

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PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Lighting Equipment

nection at the transformer, should be made effective. Either more driven electrodes and soil treatment or buried electrodes with low resistance to ground, should be provided.—F.N.M.S.

SERVICE ENTRANCE CABLE

Q. *"May service conduit or service entrance cable enter the service equipment cabinet through the top in barns housing livestock?"*—I.S.

A. While this question apparently is not fully answered by the National Electrical Code, experience has proved that it is not good practice and should not be permitted. This is especially true of conduit, and of cable only when its length within the room is not sufficient to bring the individual conductors within the cabinet to ambient temperature. During winter months, humidity within buildings of this type stays at a relatively high level and should conduit or cable enter the top of the cabinet, condensation may form and drop onto the switch block. Inasmuch as this condensation will gather on the bottom of the cabinet, it is advisable to keep conductors off the bottom and make sure the cabinet has a deep hole to prevent any appreciable accumulation forming. It is also good practice to give the same consideration to circuits leaving the service equipment and extending into cold portions of the building such as the hay mow.—G.R.

SN WIRE IN WET LOCATIONS

Q. *"This office is considering the installation of electrical equipment in a structure that would be considered a damp location, as defined in Article 100 of the National Electrical Code.*

"Information is requested as to the advisability of installing type SN conductors in such a structure. The conductors would be installed both in electrical metallic tubing and in flexible metal conduit."—C.K.P.

A. Type SN (synthetic insulated) wire is not approved for use in wet or damp locations and probably would not stand up much longer there than type R (rubber covered) wire.

Type RW (moisture-repellent rubber covered) wire was developd to take the place of type RL (lead covered, rubber insulated) wires in wet locations but due to WPB orders has been off the market for some time.

There has now been developed and approved for use in wet locations a building wire to replace the RL and RW wires, this one having a moisture repelling synthetic insulation, known as type SNW wire. Tags on the coils or reels of this type of wire bear the statement "For use in wet locations where the temperature does not exceed 50° C." The conductors are made in sizes No. 14 to No. 4/0.

This type wire could be used in electrical metallic tubing or flexible metal conduit wherever this type of raceway would be approved. With the EMT it would be preferable (and required) to use the water-tight fittings.

The type SNW wire would be preferable to use if any oils or similar substances which are deleterious to rubber are present as the synthetic compound is not affected by gasoline and oils as rubber is. This type wire will come in very handy around gasoline stations.—F.N.M.S.

OFFICIAL INTERPRETATIONS

by the

Electrical Committee of the N.F.P.A.

Interpretation No. 254

QUESTION . . . Was it the intent that section 3249 (Article 324) and 3370 (Article 336) be interpreted as applying to the use of the newer types of thermal insulation in the shape of batts or blankets installed within wiring spaces but maintained at least one inch from conductors or cables?

ANSWER . . . The use of the batt form of insulation was not considered when these sections were adopted.

Interpretation No. 255

QUESTION (a) . . . Is it intended that motors driving extractors and tumblers in laundries be considered as used for intermittent and similar duty and protected against overcurrent by the branch-circuit overcurrent protective device as provided in section 4323 of the 1940 edition of the National Electric Code?

ANSWER (a) . . . No; this section is intended to apply where the driven apparatus is of such a nature that the motor cannot be operated for more than short periods, or if operating continuously the load can be applied only for short periods. Under these conditions of service, heating of the motors or of the conductors cannot be excessive.

QUESTION (b) . . . By whom is it determined that the requirement for service by a motor is continuous, intermittent, periodic, short-time, or varying?

ANSWER (b) . . . The authority enforcing the Code.

● **Amerclad Type S** is a heavy-duty portable cord for electrical tools and similar applications where the cord is subject to extremely rough usage. *Type SJ*, having a lighter jacket, is designed for use in homes, stores and offices.

● **Amerclad Welding (Electrode-Holder) Cables** feature extreme flexibility and light weight combined with typical Amerclad toughness. They are easy to manipulate, lie flat and can be moved without kinking or snarling.

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EVER notable for long life, Amerclad Cords and Cables are built tough to stand the hard knocks of wartime speed-up. Light, flexible and easy to handle, they can be pulled through puddles, dragged over rough ground, subjected to abrasive wear, or exposed to severe chemical action. Yet they keep right on delivering an uninterrupted flow of power. Their stamina is built in.

Even now, when crude rubber is not available and the use of Neoprene is greatly restricted, we have developed synthetic rubber compounds for use in Amerclad Cords and Cables to carry on the old tradition of trouble-free service.

Here's an invitation. Pick out your toughest portable cable job. Next time that cable needs replacement, use Amerclad. You should have the benefit of the time- and money-savings that Amerclad insures.

Building Wire — Rubber or Synthetic resin insulation
Non-Metallic Sheathed Cable
Service Entrance and Drop Cable
Power Cables — Rubber, Varnished Cambric or Paper Insulation
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Non-Metallic Parkway Cables
Rubber-sheathed Cords and Cables
Heat-proof Asbestos Insulated Cables
Weatherproof and Annunciator Wire
Magnet Wire of all types and sizes
Galvanized Steel Wire and Strand
Rural Distribution Conductors.

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United States Steel Export Company, New York

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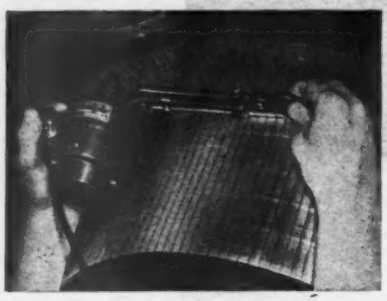
UNITED STATES STEEL

HULLHORST UNDERCUTTER



PORTABLE NO. 62

● Here is a light weight—compact—handy—portable mica undercutter ideally suited for industrial maintenance men and motor repair shop crews.

LIGHT WEIGHT—weighs only 4 lbs.

COMPACT — Gets into smaller spaces.

CAPACITY— Undercuts horizontal commutators up to 30" dia.

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SMALL CUTTER—Allows smooth operation, gets closer to riser—lower cutter cost.

BLOWER—Ample for blowing mica dust away for best visibility.

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The price of the No. 62 Undercutter with 110 Volt Universal DC motor or 25 to 75 cycle AC includes carrying case, bar, screw driver and 20 Hullhorst High Speed Steel (¼") Cutters —4 each of .015", .025", .030", .035" thickness or assorted as you want them. Also furnished with 220 Volt Universal motor at slight increase in price.

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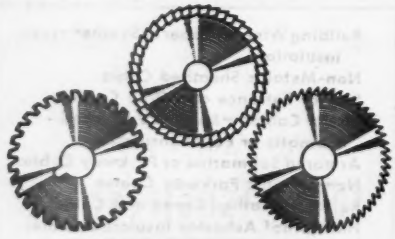
A compact, high production, undercutting machine, handling armatures up to 6½" in dia. and shafts up to 17¾" long. Built specifically for manufacturers and large electrical service shops.



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Interpretation No. 256

STATEMENT . . . A 150 horsepower synchronous three-phase, 220-volt, 60 cycle motor, Code letter E, has auto-transformer reduced voltage starting with running overload protection, full load rating 320 amperes. According to Table 26 the maximum rating of overcurrent device for the motor branch circuit is 200 per cent of the full load rating of the motor.

QUESTION 1 . . . May a general-use type knife switch be employed as the disconnecting means for the motor and its branch circuit?

ANSWER 1 . . . Yes, see paragraph c of section 4402; see section 4403 for carrying capacity of switch.

QUESTION 2 . . . May fuses be employed for overcurrent protection of the branch circuit?

ANSWER 2 . . . Yes, if the largest available size of fuse (600 amperes) will permit the motor to start under all operating conditions; time-lag fuses are permissible.

QUESTION 3 . . . May a circuit breaker of suitable current rating serve as a disconnecting means as well as for the motor branch circuit overcurrent protective device?

ANSWER 3 . . . Yes, if the requirements of the Code for both purposes are satisfied.

Interpretation No. 257

QUESTION . . . May the sheet metal of a sign structure or metallic supporting frames of signs be used in whole or in part as a conductor in the secondary circuit of high voltage electric signs or fixtures?

ANSWER . . . No, paragraph a of section 6034 expressly prohibits contact with terminals of gas tubing with grounded metal whether enclosed or not. Consequently the conductor from a terminal must be insulated.

VIC MOULTON, engineer for Rocky Mountain Inspection Bureau and secretary-treasurer of the Rocky Montain Chapter, IAEI, watches a new threaded thin-wall tubing fitting which Jim Mahan, representing Briegle Tool, brought to the annual inspector meeting in Denver. Charles B. Farrah, electrical inspector, Denver, and chairman of the chapter, is trying the threads.

Interpretation No. 258

STATEMENT . . . A group of fueling pits at an airport is located out of doors well detached from any building. Fuel pumps and control equipment are installed in each pit. The conductors supplying the motors are in conduit within the pit and in fibre ducts between pits and also between the first pit and the point within the building 60 feet distant at which they are supplied and controlled. The conduit is cut off outside of this building and within each pit by means of pull boxes each filled with sealing compound.

QUESTION . . . Does this subdivision of the conduit raceway satisfy the requirements of section 5014-b, items 1, 2, and 3?

ANSWER . . . Yes, if the sealing compound is approved for the purpose.

Interpretation No. 259

QUESTION . . . Is it permissible to use vaportight lighting units in outdoor open-type structural steel structures with grating floors, wherein are located vessels and piping containing flammable hydrocarbons? Also, on platforms adjacent to walkways or on connecting vessels and/or buildings wherein flammable hydrocarbons are stored or handled? If so, under what circumstances, if any?

ANSWER . . . It has not been the intent of the Electrical Committee that so-called vaporproof or vaportight lighting fixtures be recognized as providing the safeguards intended for explosion-proof equipment such as is specified in section 5020. Reference is made to Interpretation No. 227, the finding of which reads:

"Section 5001 contemplates that the authority enforcing the code shall determine when a particular premises or installation of apparatus conforms to the code description of a hazardous location. Generally speaking, close proximity to a bulk station warrants classification of an electrical equipment as in a hazardous location."

Interpretation No. 260

QUESTION . . . May metallic outlet boxes be employed when the wiring method is as per section 3372 (Interim Amendment No. 43) if insulated sleeving is used over the exposed ends of the uninsulated grounded neutral conductor.

ANSWER . . . No.

Interpretation No. 261

STATEMENT . . . A frame building is to have an inaccessible attic. The wiring method will be with non-metallic sheathed cable, Article 336.

QUUESTION . . Is it required that cable be secured at intervals of 4½ feet?

ANSWER . . . Yes, the provisions of sections 3363 and 3366 both apply. Fish work or its equivalent is permissible only for wiring in "finished buildings."

YOU WOULDN'T HAVE WANTED IT ANY OTHER WAY

Billions of feet of "U. S." wires and cables have been shipped to our fighting fronts . . . wires and cables badly needed by you here at home . . . but indispensable to our Armed Forces.

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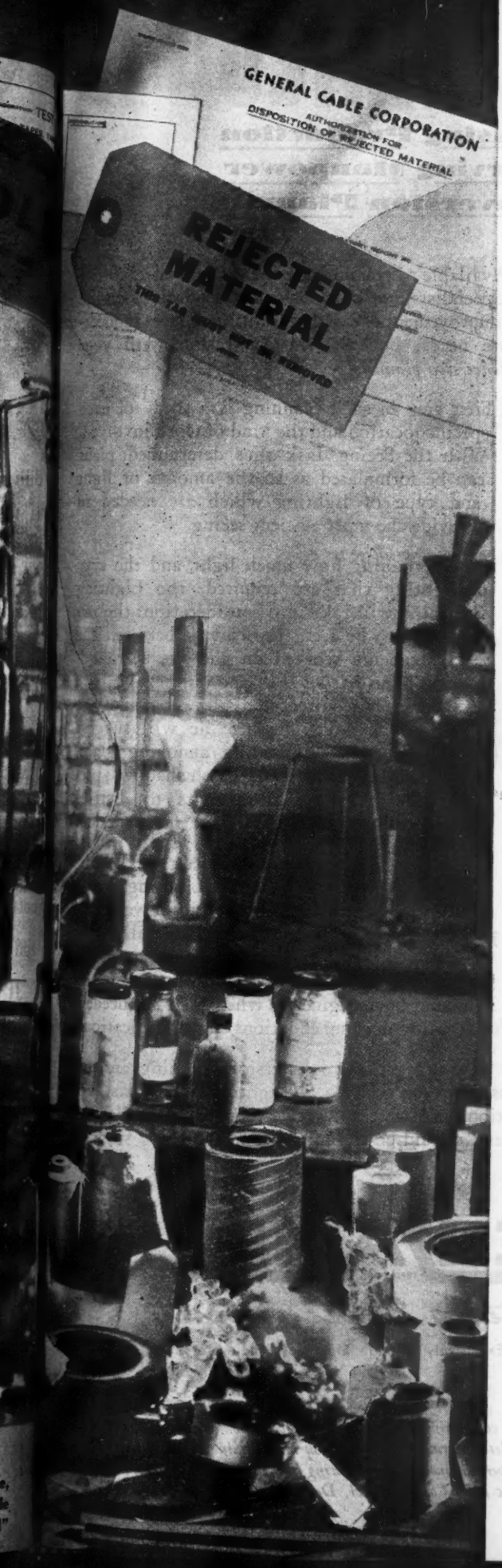
AL CABLE'S OWN "BUREAU OF STANDARDS"



Assurance of standardized quality in the electrical wire and cable products supplied by General Cable starts with our firm control of raw materials. To insure absolute uniformity at all 9 manufacturing plants, each material used is accepted or rejected by the "Control Testing Laboratories" situated in each plant, to specifications established by the General Research Laboratory at Bayonne. The time of an entire Bureau of the General Research Laboratory is devoted to the setting of these standards and the devising and supervising of uniform tests to enforce them. Under such a program one does not have to hope for or demand quality control — one gets it.

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Conserving Manpower
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First step in such planning is a study of each specific location and the kind of work involved. With the Seeing Task thus determined, plans can be formulated as to the amount of light and type of lighting which are needed to provide the most efficient seeing.

In determining how much light and the type of lighting that are required, the Lighting Specialist will take into consideration: the *size of detail* to be seen; the *contrast* between the object being worked on and the surroundings; the *brightness* of the object; the *speed of seeing* required; and, the *duration* of the visual task. Further, he will suggest ways of eliminating annoying glare, sharp contrasts and harsh shadows; prescribe proper lighting units to distribute and direct the light where most needed.

By calling upon your local Electrical Wholesaler who distributes Benjamin Lighting Equipment or upon your local Light and Power Company, the services of a Lighting Specialist may be obtained without cost or obligation. Available through them, also, is the assistance of Benjamin field engineers, when such are needed, for lighting recommendations and specifications.

Many manufacturers now engaged in reconversion planning are utilizing the aid and assistance of their local Lighting Specialists. For lighting is a production tool that goes hand in hand with all other production tools . . . and should be considered concurrently.

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Send for a copy of this FREE BOOKLET containing much valuable information on how to obtain best lighting results. With it will be sent complete information on how you may obtain the assistance of the Benjamin Field Engineer in analyzing the performance of your lighting and in making recommendations. Address Lighting Service, Benjamin Electric Mfg. Co., Dept. H, Des Plaines, Illinois.

INDUSTRIAL ELECTRIFICATION

ENGINEERING • INSTALLATION • MAINTENANCE

Selection and Application of Wound Rotor Motors—I

Salient features of the wound rotor motor are explained in detail for its proper selection and application to modern industrial drive.

By E. H. Fredrick
Electrical Department
Allis-Chalmers Mfg. Co.
Milwaukee, Wisconsin

THE increasing use of processes requiring variable speed has in recent years brought added emphasis to the use of simple adjustable speed drives. In many instances, close control of speed is essential, and elaborate equipment to obtain the desired accuracy and fineness of speed regulation is economically justified. However, in most instances, the speed adjustment is not required to be closely controlled, and since first cost of the drive is generally a matter of importance, the wound-rotor motor provides characteristics suitable to successful application.

The direct-current motor is unequalled for adjustable speed service, but in many plants, especially smaller ones, a direct-current power supply is not available and unless conversion equipment is installed, these plants must rely on alternating-current motors for their variable speed drives.

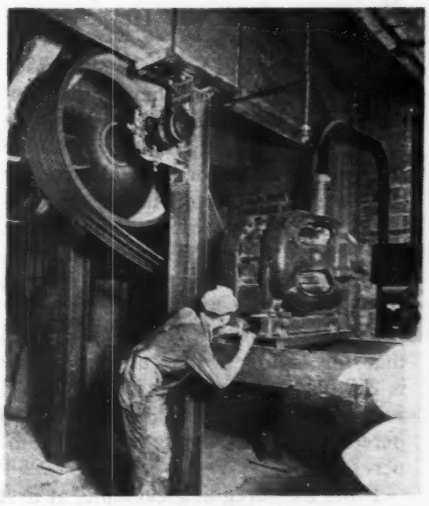
Since alternating-current is almost universal in its use, a variable speed alternating-current motor is the simplest and most direct answer to the problem. The only common type of alternating-current motor capable of easily fulfilling the requisite of speed adjustment is the wound-rotor induction motor.

In general industrial use, the increasing popularity of induction motors, especially those of the squirrel-cage type, is not a mysterious phenomenon. The squirrel-cage induction motor is the simplest, cheapest, most rugged and most easily maintained of all motors. The normal cage motor, however, has the disadvantage of high starting current for the amount of starting torque developed, and is, basically, a constant speed motor. But these objectionable features are readily overcome by the use of a wound-rotor induction motor, as will be developed later.

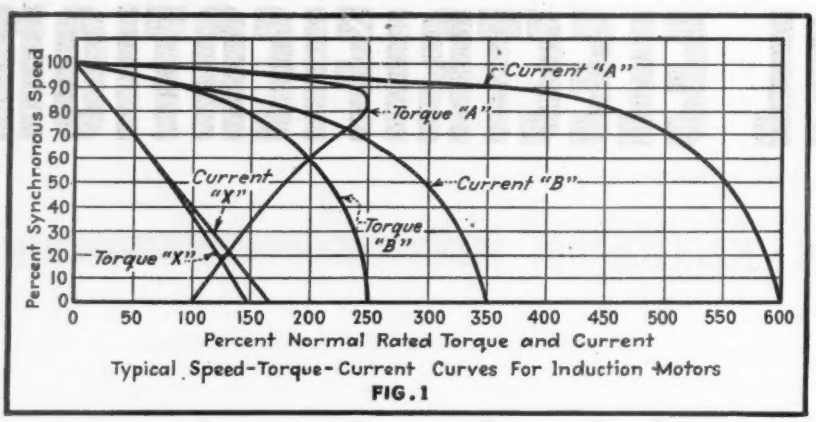
In any type of induction motor, the speed-torque characteristic is largely dependent upon the resistance of the rotor circuit. For example, certain types of squirrel-cage motors are built with high resistance rotors. This design feature allows the motor to develop high starting torque at relatively low current inrush. However, offsetting these obvious advantages is the fact that a squirrel-cage motor with a high resistance rotor has a decidedly drooping speed characteristic; that is, its slip is relatively high, and its maximum torque is developed at greatly reduced speed.

Curve A in Fig. 1 shows how the torque of a normal starting current, normal torque cage motor varies with speed. Curve B shows this same char-

WOUND-ROTOR MOTOR of 15 hp., used to operate a 4½ by 6 triplex piston pump for the sprinkling system in a large government building.



A TYPICAL APPLICATION of a wound-rotor motor to a line shaft drive. The motor is rated 100 hp., 860 rpm., and has enclosed slip rings.



Typical Speed-Torque-Current Curves For Induction Motors
FIG. 1

acteristic for a motor with a high resistance rotor. Both motors have the same maximum torque, however the maximum torque is developed by each motor at a different speed. Furthermore, note the relative amounts of starting currents of the different types of motors.

As an example, a 25 hp. 1160 rpm. motor has a full load torque value of

$$5250 \times \frac{hp}{rpm} = 5250 \times \frac{25}{1160} = 113$$

lbs. ft. For a 440 volt motor with a full load efficiency of 88 percent and full load power factor of 85 percent, the rated current will be 32.8 amperes. From Curve A in Fig. 1 we see that this motor, if built for normal torque, normal starting current duty, will develop 100 percent of its rated torque or 113 lbs ft. at starting but it will draw 600 percent of rated current or 197 amperes to start.

If the high slip motor (characteristic shown by Curve B) is used, it may be seen that this motor develops its horsepower rating at 90 percent speed or 1080 rpm. Therefore its full load torque will be increased to $5250 \times \frac{25}{1080} = 122$ lbs. ft. However, the decreased speed of operation increases the losses in the rotor, thereby decreasing the full load efficiency, in this case to about 82 percent. This decrease in efficiency is to a minor extent offset by an increase in power factor, but for illustrative purposes it is assumed that the power factor remains constant. With these conditions the rated current is 35.2 amperes.

Again referring to Fig. 1, it is seen that for motor B the starting torque is 250 percent, in this case 305 pounds feet, while the starting current is 350 percent of rated current or 123 amperes.

From the foregoing example, at first sight it would appear that the motor indicated as B has everything in its favor except efficiency. Certain other factors are present which counteract the obvious advantages, though. First of all, note that both motors have a maximum torque of 250 percent of rated torque. With motor A this peak torque is available at about 87 percent speed or 1045 rpm. With motor B the machine will be almost stalled before the maximum torque is developed. Obviously, on a fluctuating load, the speed of the motor designated as B will be very unstable during the peak demands, while A will operate at relatively constant speed.

Another item to consider is the fact that since the I^2R losses in the rotor are necessarily increased by the use of a high resistance cage winding, the machine must be physically larger and therefore more expensive than motor A for a similar temperature rating.

This high resistance rotor design could be carried out further to build a cage motor with a characteristic like that of X on the curve, but such a machine would not be practical since the disadvantages of motor B would be magnified to such an extent as to make the performance very poor and the cost of building and operating the machine prohibitive.

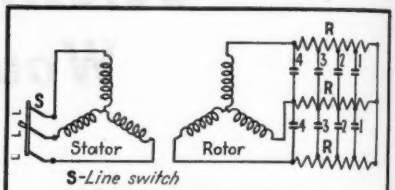
Low Starting Currents

The study of the curves shows that for starting conditions the low current and relatively high torque of motor X are ideal, but the poor speed regulation and low maximum torque does not give particularly good running characteristics. Curve A, on the other hand, shows superiority of performance under running conditions, while at starting, its relatively low torque and high inrush current are obvious disadvantages.

Now, if a motor can be built in which the resistance of the rotor circuit can be changed at will, the operating characteristics of the motor could be altered to suit conditions. The motor could be started with high rotor resistance, giving high torque with low current inrush; and as the machine came up to speed, the resistance could be decreased to conform to characteristics approaching those of curve A. That is exactly what is done in the case of a wound-rotor motor.

By using a phase wound, insulated rotor winding and bringing the leads of these windings to slip rings, the insertion of resistance in the rotor circuit is made possible. Naturally, the amount of resistance in the circuit is easily controlled, thereby giving control of the motor's speed as well as its starting characteristic. Fig 2 shows the simple connection diagram for a wound-rotor motor.

In starting a wound-rotor motor, the stator winding is connected directly to



S-*Line switch*
1,2,3,4 - *Secondary contactors*
R-*Secondary resistors*
Diagram of Wound Rotor Motor Connections
FIG. 2

the line with all contactors in the secondary control open. Under this condition, the rotor circuit is closed through a relatively high resistance. As the motor accelerates, contactors (1) are closed, then in succession (2) and (3) and finally (4) are closed, so that when the motor has approached full speed the rotor winding is short circuited, and the motor is operating substantially as a squirrel-cage motor with a low resistance rotor.

By proper adjustment of the secondary resistance in the rotor circuit, the maximum torque of the motor may be had at starting without greatly exceeding an inrush current directly proportional to the percentage torque obtained. As the motor comes up to speed, if the secondary resistance is constantly reduced, the maximum torque of the motor can be maintained all the way up to full speed. This action is clearly shown in Fig. 3. If the starting resistance is regulated so that the characteristic of the motor will lie along Curve A, the starting torque will be approximately 150 per cent of normal full load torque and the current inrush will be slightly more than 150 per cent of full load current. As the motor starts to turn, it will accelerate with decreasing torque along Curve A, eventually running at close to synchronous speed, if the torque requirements are very low.

Operation at Reduced Speed

The dotted curves 1 and 2 in Fig. 3 show the torque requirements of (1) a typical centrifugal pump, and (2) a typical constant torque load, such as

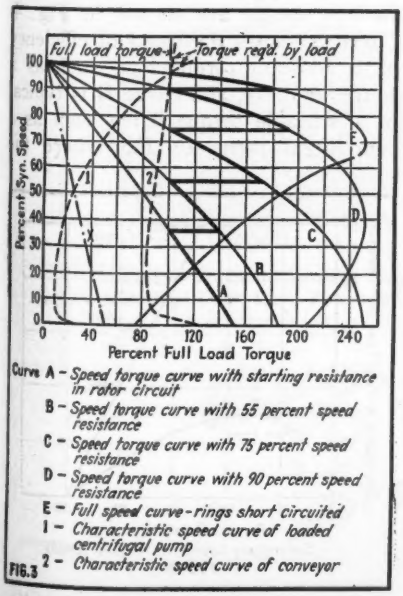
a conveyor. In order to design the secondary resistor properly, the type of load must be known, as will become evident a little further on.

If the load torques are as indicated by the load torque curves on Fig. 3, the motor will start to turn and accelerate to the point where the motor torque curve crosses the load torque curve. In other words, the pump would be accelerated to a speed of about 70 percent, while, in the case of a conveyor load, the final speed would be about 45 percent of synchronous.

To illustrate, a certain pump requires 25 hp. at 1160 rpm. under full load conditions. Centrifugal pumps require a torque which will vary approximately as the square of the speed. In this case, at full speed, the pump needs 113 lbs. ft. to keep it going. In general, its torque demand will follow Curve 1 in Fig. 3. If the wound-rotor motor driving this pump were allowed to operate on the first step of resistance (indicated by Curve A), the drive would accelerate to 70 percent or 840 rpm. At that point the pump requires 44 percent rated torque or about 50 lbs. ft. At this same speed point the motor develops 50 lbs. ft. of torque and therefore there is no excess torque available to accelerate the drive further, and it will operate at that speed until the torque demand by the pump or the torque output of the motor is altered. The action in the case of the conveyor drive is very similar except that on the first step the drive would operate at 540 rpm, since the torque demand of the conveyor is greater than that of the pump for any speed below rated speed.

Obviously, this operating condition would not be practical unless the reduced speed were desirable for special operation of the drive. But with a slip ring motor, we have control of the characteristic. By cutting down the external resistance in the rotor circuit we can bodily shift the torque curve to a characteristic indicated by Curve B, which will give us greater torque at any given speed. On Fig. 3 this transition from Curve A to Curve B is indicated by the heavy horizontal line drawn between Curves A and B. If left in this condition, the motor would now accelerate its pump load to about 75 percent speed or 900 rpm, or its conveyor load to about 60 percent or 720 rpm. Note that the pump load has gained only 5 percent in speed but the conveyor has gained 15 percent by the transition.

If we wish to accelerate the loads still further, the resistance of the rotor circuit can be still further decreased and the torque and speed will vary along the heavy zig-zag line up to the short circuited rotor position indicated by Curve E. It is interesting to note that the shape of Curve E is very similar to that of the normal torque normal starting current cage motor as shown in Fig. 1. In fact, if the slip ring motor were operated with its rings short circuited from stand still to full speed, its torque characteristics will approximate those of the cage motor. Under these conditions, the machine we have used as an example would have a starting torque of approximately 75 percent with an inrush of probably 600 percent or more. In comparison, by starting the wound-rotor motor on the first step of resistance (Curve A) the current inrush has been reduced to 150 percent with a starting torque of 150 percent. Thus we see that the slip ring motor is well adapted to drives in which it is imperative to obtain a high starting torque with a very low inrush.

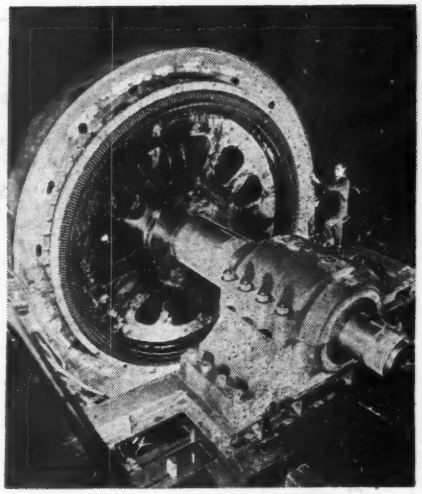


Curve A – Speed torque curve with starting resistance in rotor circuit
B – Speed torque curve with 55 percent speed resistance
C – Speed torque curve with 75 percent speed resistance
D – Speed torque curve with 90 percent speed resistance
E – Full speed curve - rings short circuited
1 – Characteristic speed curve of loaded centrifugal pump
2 – Characteristic speed curve of conveyor

FIG. 3

Stability Poor at Low Speeds

Quite obviously, if the secondary resistor is allowed to remain in one of the reduced speed positions the motor will not attain its full speed unless the load is relieved. For example, if we wish to operate the conveyor at 75 percent speed and we know its load will remain practically constant, the secondary resistor, provided it is built for continuous duty, can be set at the point indicated by Curve C in Fig. 3 and the motor will operate at the required speed. However, it must be borne in mind that any change in load will be accompanied by a change in speed. If the load is entirely removed the motor will accelerate to synchronous speed regardless of the amount of resistance in the secondary circuit. Speed reductions down to 50 percent of synchronous speed are common with almost any type of load. With a constant torque load even further reductions can satisfactorily be made, but with variable torque loads, such as fans and centrifugal pumps, the stability of the motor below half speed is poor.



WOUND-ROTOR MOTOR of 3500 hp., 147½ rpm., for use on a rolling mill is pictured above. This motor is being used with a flywheel mounted on its shaft and operates with a liquid slip regulator which controls the motor speed to allow the flywheel to perform its function.

The stability of speed under reduced speed conditions is dependent on the stability of the torque demand. In Fig. 3, the relationship between torque available from the motor and that required by the load is clearly illustrated. The magnitude of the angle between the two curves is a measure of speed stability. For instance, consider the condition at full speed operation. At the full load, full speed point the motor torque balances the torque required by the pump. If the torque demand of the pump increases by, say 10 percent, the motor will automatically drop back in speed by about 1 percent or about 12 rpm. and provide the required increase in torque. This function is performed with such a small change in speed because the torque may go to 180 percent —an increase of 80 percent above normal—without the speed dropping below 90 percent of synchronous, as shown in the motor torque curve.

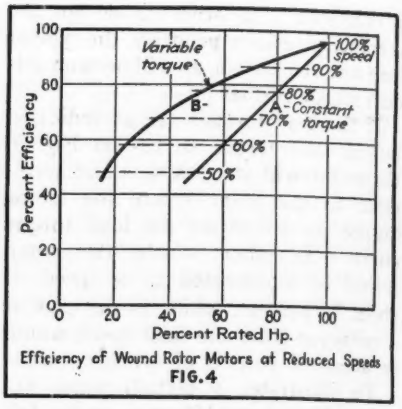
However, if it is desired to operate the pump at 50 percent speed, the controller would have to be adjusted to provide a motor torque curve as X. Now, if when operating at this speed (600 rpm) the pump torque increases from 25 percent (normal) to 27½ percent (a 10 percent increase) the speed would drop from 600 rpm. to about 500 rpm, a speed reduction of over 16 percent. Thus, we see that the speed stability is adversely affected by reduced speed operation.

The power absorbed in the secondary resistance of the control is proportional to the reduction in speed at constant torque, and therefore, the horsepower

TABLE A

Table of suitable drives for a number of typical applications

Loads	Squirrel Cage	Wound Rotor	Synchronous	Direct Current
Agitators, Dorr, Deveraux	X			
Attrition Mills	X	X	X	
Banbury Mixers		X	X	
Bandsaw Mills		X	X	
Barking drums, logs	X	X		
Beaters, pulp	X		X	
Blowers	X	X	X	X
Calendars, Paper				X
Rubber				X
Car Dumpers, Rotary	X	X		X
Car Hauls	X	X		X
Chippers, Wood	X		X	
Classifiers	X			
Compressors, Reciprocating	X	X	X	
Air and Gas	X	X	X	
Ammonia	X	X	X	
Carbon Dioxide	X	X	X	
Freon	X	X	X	
Centrifugal	X	X	X	
Conveyors	X	X		X
Cranes, Hoist		X		X
Trolley		X		X
Crushers, Cone	X	X	X	
Gyratory	X	X	X	
Jaw	X	X	X	
Roll	X	X	X	
Edgers, Sawmill	X		X	
Elevators	X	X		X
Fans, Centrifugal	X	X	X	X
Propeller	X	X	X	X
Feeders	X	X		X
Flotation Machines	X			
Frequency Changers	X		X	
Generators	X		X	X
Grinders, Wood, Pulp	X		X	
Grinding Mills, Ball	X		X	
Compeb	X	X	X	
Rod	X	X	X	
Slug	X	X	X	
Tube	X	X	X	
Hammermills	X	X	X	
Hoists, Slope		X		X
Vertical		X		X
Hogs, Wood	X	X	X	
Jigs, Metal Refining	X			
Jordan Engines	X		X	
Kilns, Cement	X	X		X
Line Shafts, Flour Mills		X	X	
Rubber Mills		X	X	
Log Hauls	X			
Planers	X			
Plasticators, Rubber		X	X	
Pulp Grinders	X		X	
Pulverizers, Ball Type	X	X	X	
Centrifugal	X	X	X	
Pumps, Centrifugal	X	X	X	X
Mixed Flow	X	X	X	
Axial Flow	X	X	X	
Reciprocating	X		X	
Vacuum, Hytor	X		X	
Refiners, Wood	X		X	
Roasters	X			
Rubber Mills, Rolls	X		X	
Saws, Band		X	X	
Resaw, Band		X	X	
Edger, Circular	X			
Gang, Circular	X		X	
Trimmer			X	
Screens, Paper Mill	X		X	
Shaker Screens	X			
Shredders, Wood	X	X	X	
Stokers	X			
Sugar Centrifugals	X	X	X	
Cutter Heads, Dredge		X		X
Fans, Sintering	X		X	

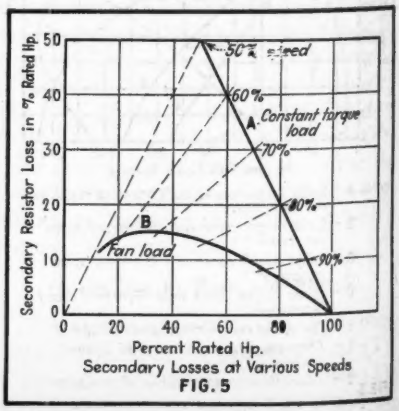


Efficiency of Wound Rotor Motors at Reduced Speeds
FIG. 4

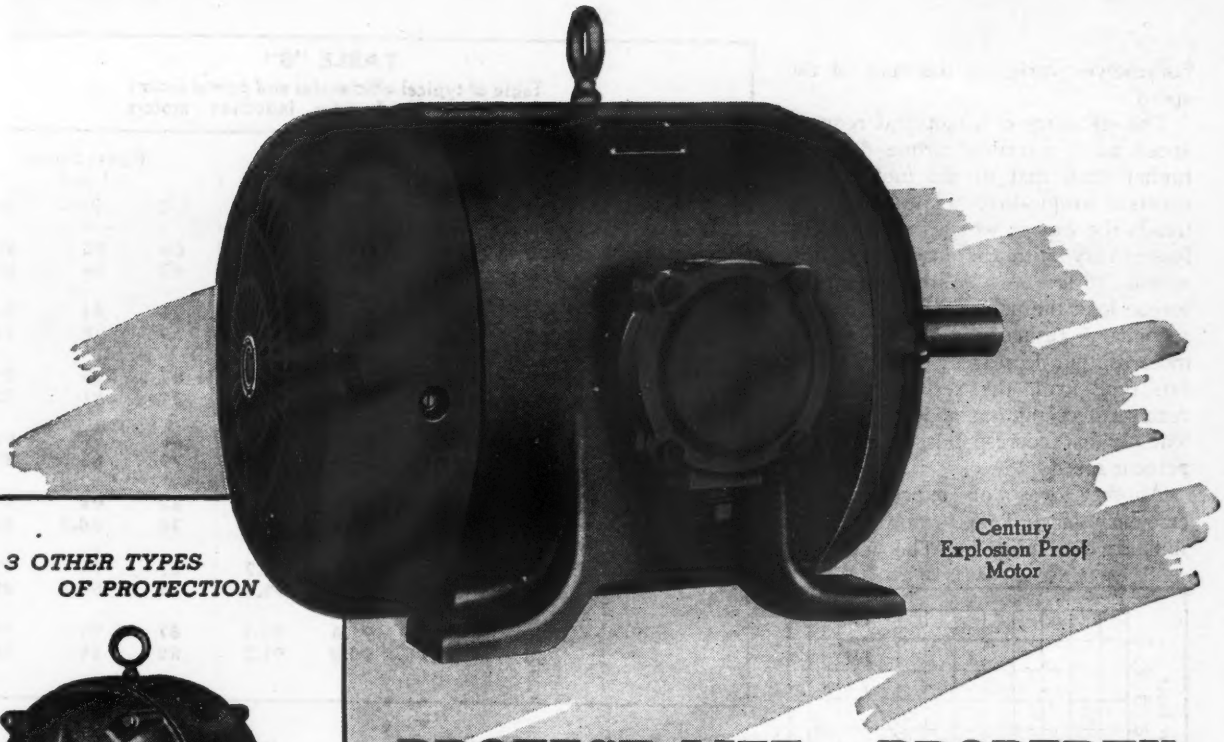
input to the stator will be approximately constant at all speeds. Since with a constant horsepower load, torque increases as speed decreases, and since current is proportional to torque, the power output capacity of the motor will decrease with a reduction in speed. For that reason the wound-rotor motor is unsuitable for a drive where the horsepower requirement is independent of speed. For example, when a 100 hp., 1200 rpm. motor is running at 600 rpm, about 50 hp. will be dissipated in the secondary resistance and about 50 hp. will be available at the shaft. The motor is developing only 50 shaft horsepower, but 100 hp. must cross the air gap and the power input to the motor will still be 100 hp, neglecting the variation in motor losses.

Efficiency of Wound Rotor Motor

This same condition holds for any drive which depends upon slip for its speed adjustment. Magnetic and hydraulic couplings and d.c. motors with armature resistance control follow the same general rule. Because of this condition, it is evident that the efficiency of a wound-rotor motor is low at reduced speeds. Typical efficiency curves for wound-rotor motors at various speeds are shown in Fig. 4. Curve A shows the trend of efficiency on a constant torque load such as a conveyor drive, and curve B is typical of a variable torque drive such as a centrifugal pump or fan where the



Secondary Losses at Various Speeds
FIG. 5



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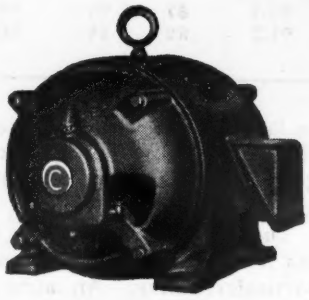
Century Explosion Proof motors are made with many variations in operating characteristics, such as high torque, normal torque, low torque, multiple speed.

Forced air cooling fans carry off the heat produced by the motor operation. This keeps the vital parts of the motor cool and, in addition, blows dust out of the air passages and keeps the motor frame clean.

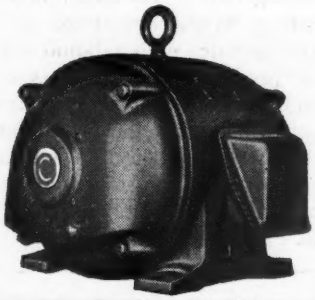
The contour of the motor frame is smooth and streamlined, making it easier to keep the outside of the motor clean and neat in appearance.

If hazardous atmospheric conditions are a problem in your plant, ask a Century engineer to give you complete information on Century's Explosion Proof motors.

3 OTHER TYPES OF PROTECTION



Form J — General Purpose Application



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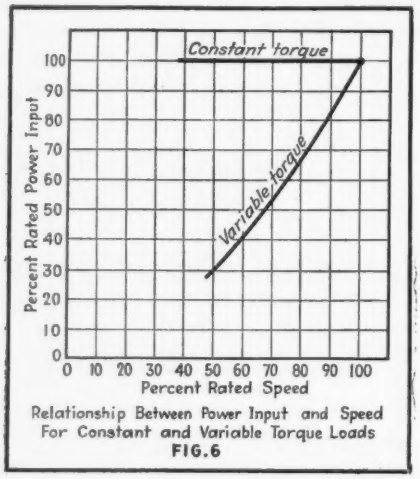
horsepower varies as the cube of the speed.

The efficiency of a motor at reduced speed on a variable torque drive is higher than that of the motor on a constant torque load. The reason for this is the way in which the secondary losses vary with the load at various speeds (Fig. 5). With a constant torque load the power absorbed by the secondary resistor increases as the motor output decreases; while with the fan type load, the secondary losses reach a maximum at about 30 percent load, which corresponds to about 66 percent speed.

Another way of expressing the efficiency of a wound-rotor motor is illustrated by Fig. 6. The curves in this figure show a comparison between power inputs at various speeds. Note that for a constant torque load the power input is practically constant regardless of speed, even though the power output decreases in direct proportion to the decrease in speed. However, for a fan or centrifugal pump load, the input decreases materially under reduced speed conditions since the power required by the load decreases as the square of the speed.



Relationship Between Power Input and Speed For Constant and Variable Torque Loads
FIG.6

TABLE "B"

Table of typical efficiencies and power factors 440 volt wound rotor induction motors

HP	RPM	Efficiency Load 1/2	Efficiency Load 3/4	Efficiency Load 4/4	Power Factor Load 1/2	Power Factor Load 3/4	Power Factor Load 4/4
1	1800	76.7	80.6	81.0	66	76	82
	900	70.7	73.1	73.5	42	54	62
5	1800	85	86	85.5	76	84	88
	900	82.5	83.5	83.5	59	70	77
20	1800	86.2	87.8	87.5	87	91	92
	900	86.7	87.3	86.5	71	81	85
50	1800	88.5	89.7	89.5	88	92	93
	900	89	89.7	89	79	86	88
100	1800	89	90.2	90	88	92	93
	900	88.5	89.8	89.8	76	84.5	88.5
150	1800	89.5	91.2	91.7	87	91	92.5
	900	89.5	91	91.2	76	84.5	88.5
200	1800	90	91.6	92.1	87	91	92.5
	900	88.9	90.8	91.7	82	88	90

Space Requirements

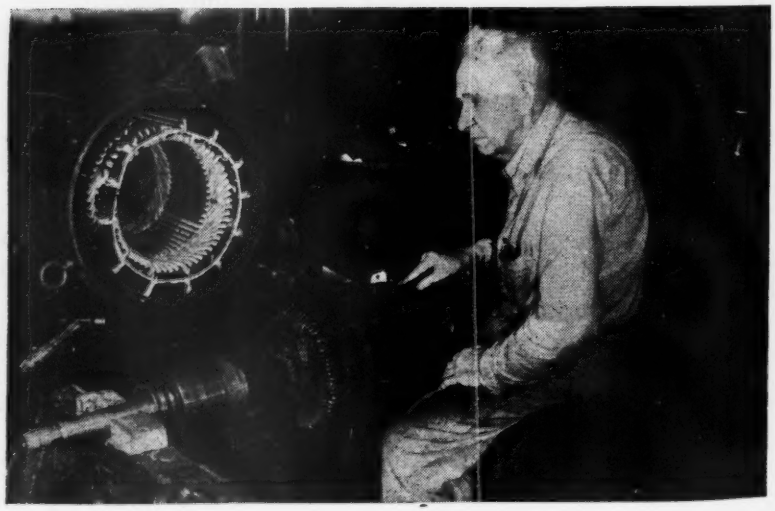
The wound-rotor motor has the mechanical advantage of being a self-contained unit and it usually requires less space than any other comparable a.c. variable speed drive. The control, however, is much larger than that required for other a.c. motors, but the secondary resistors, which are the bulk of the control, can be mounted away from the motor, so this disadvantage is usually not objectionable.

The most common type of control for smaller motors is the manually operated drum connected to grid resistors. If required, the drum can be driven by a reversible motor to make remote operation simple. Drum controls are suitable only up to 500 hp., because of current limitations of the contacts. Controls for motors above 500 hp. are nearly always of the magnetic type and easily adaptable for remote or automatic operation.

The number of speed points in a wound-rotor motor control is usually limited to eleven, for mechanical reasons. This, obviously, is a disadvantage since fine speed adjustment is not possible with such a limited number of speed points.

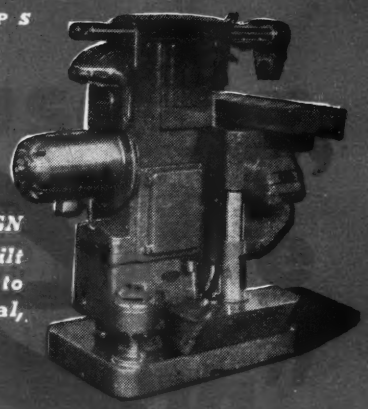
Liquid slip regulators give stepless speed control and hence much better performance than a drum type rheostat which is limited to a definite number of control points. However, the cost of such a unit and the complications of control usually prohibit its use except on large drives. Automatic liquid slip regulators are used for flywheel motor-generator sets and for constant torque loads in the larger ratings.

The use of a wound-rotor motor is not limited to or even favored for any particular rating. An accompanying photo shows a large wound-rotor motor rated 3500 hp., 147½ rpm, for use on a rolling mill. This motor is being used with a flywheel mounted on its shaft and operates with a liquid slip regulator providing the necessary control of motor speed to allow the flywheel to perform its function. (The function of the flywheel when used with a wound-rotor motor, construction details and mechanical protection will be discussed in Part Two.)

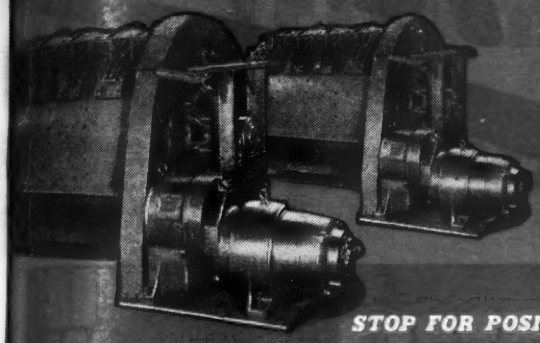


OLD TIMER *John D. Connelly, Loyd Electric Co., San Antonio, Texas, is one of the few men in the state who know how to rewind the rarity on which he is working. It is an old style, smooth core, surface wound (no slots) d.c. elevator armature. He started his career as an armature winder some 54 years ago with Kester Electric Co. in Terre Haute, Ind.*

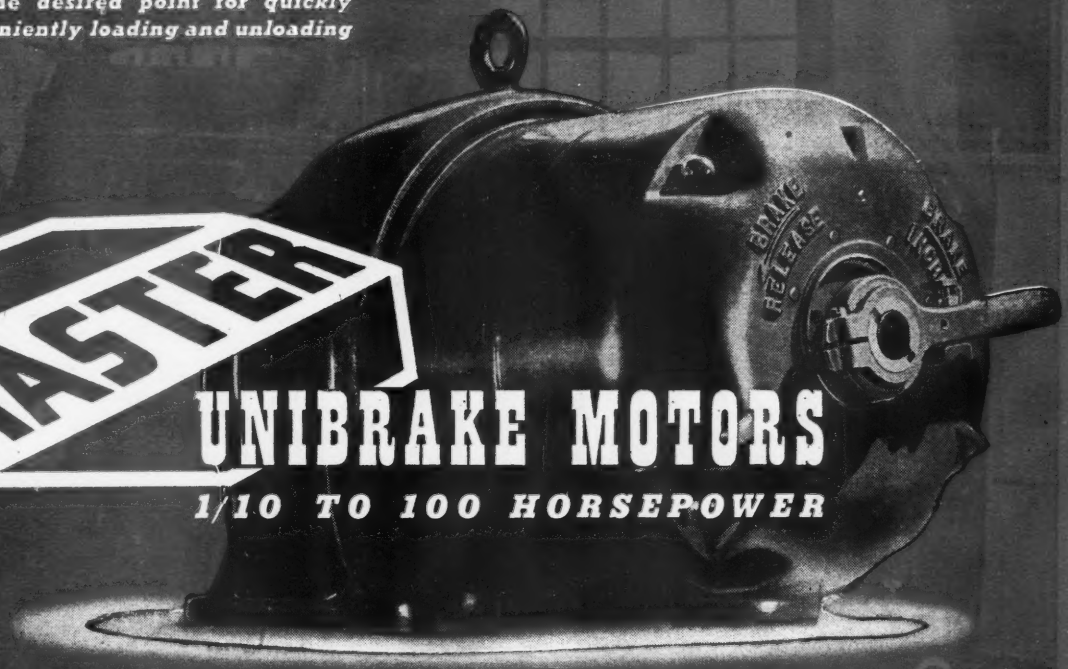
BUY UNITED STATES WAR BONDS AND STAMPS



SIMPLE COMPACT DESIGN
The electric brake is built into the motor end cover to form a compact, economical, easy to use unit.



STOP FOR POSITION
Stop at the desired point for quickly and conveniently loading and unloading



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Says **MR. FRANK MILLER, CHIEF ELECTRICIAN**
STRATHMORE PAPER COMPANY
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***HERE ARE THE FACTS*—"In June, 1937, we installed a paper trimming machine which is powered by a 7½ horsepower, 440 volt, 3 phase motor. Almost immediately, we had trouble with fuses blowing when we started the machine.**

"Then we installed BUSS Super-Lag fuses—and in seven years *we have had only one blow to date.* That proved to me the value of time-lag in fuses. Since then we have gone 100% to BUSS fuses in our 2 plants each at West Springfield and at Woronoco—and our fuse blows have been reduced by at least 30%."

In the Strathmore Paper Company plants, Buss Super-Lag fuses have again proven their ability to withstand harmless surges when motors are started under heavy load—without over-fusing the circuit. With these fuses, you can eliminate many needless shutdowns—yet have adequate protection.

Buss fuses require no maintenance or periodic inspection. They don't open needlessly. If one opens, you can be sure some condition needs correction. When one opens, it requires less than 45 seconds to renew with an inexpensive link.

Here is Why BUSS Fuses Greatly Reduce or Entirely Prevent Needless Blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give a long time-lag so that unusually heavy starting current or other harmless overloads will seldom cause the to blow.

How to solve the "shutdown" problem

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses afford.

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SUPER-LAG FUSES
SOLD THROUGH WHOLESALERS

DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

G-1

Selections and Use of Instruments

Instruments play an important part in the maintenance of all types of electric equipment. Best results in the use of instruments depend upon proper selection. The accuracy desired and the cost are the two important factors in selection.

GUIDE TO PROPER SELECTION

1. What accuracy is desired?
2. Should it be a.c. or d.c.?
3. Should it be portable or for switchboard mounting?
4. Should it be indicating or recording?
5. What is the desired rating? The range should be such that the instrument reading is usually *above* one-third scale.
6. If a switchboard instrument is desired, should it be of the surface-mounting or semiflush-mounting type?
7. Can a standard instrument listed in the manufacturer's catalog be utilized in order to obtain lowest cost and best delivery?
8. What effect will the instrument have on the circuit in which it is to be used? For example, some applications require a voltmeter with high resistance for minimum current drain. Or, an ammeter may have to have a low volt-ampere rating if it is to be used with a through-type current transformer.
9. Conditions under which the instrument is to be used are important. Indoor or outdoor, humidity, or corrosive atmosphere may require special instruments.

Any request for information on instruments should be complete with all the information shown on the instrument nameplate—its rating, serial number, when the instrument was purchased; and a description of the special conditions under which the instrument is used.

SETTING UP FOR USE

All Instruments

1. Read the manufacturer's instruction book carefully.
2. Instruments should be handled carefully to avoid all vibration or shocks which may injure the instrument bearings.
3. From the nameplate of the apparatus on which the measurement is to be made, estimate the value of the current, voltage, etc., to be measured.
4. If an instrument has more than one tap or range, make connection to the highest range first to avoid injury to the instrument.
5. Instruments should always be read when in their normal operating position; that is, portables should be in a level, horizontal position and switchboard types in a vertical position.

Portable Instruments

1. Metal benches should be avoided, as the instrument indication may be affected by the proximity of the metal.
2. Proper size leads should be used. Terminals should be clean to avoid high contact resistance, particularly in the case of millivoltmeters used with shunts. Lead wires should extend away from the observer to avoid accidentally pulling the instrument off the table.
3. Whenever a shunt is used with a millivoltmeter to read current *always check* to make sure the leads with which the instrument was calibrated are being used.
4. If external resistance multipliers are used, check both the serial number of the instrument and that of the multiplier to make sure of the correct combination.
5. The instrument zero setting should be checked. If the pointer is slightly off zero, reset to zero by adjusting external zero shifter. Never try to compensate for a bent pointer by moving the zero shifter.
6. The instrument should not be used in strong fields, such as near cables or busbars. Presence of a magnetic field which is affecting the reading of an instrument can be detected by turning the instrument (clockwise or counterclockwise) 90 degrees at a time, and taking a reading in each position. If a difference is noted in the readings, some stray field is present.
7. Unshielded instruments should not be placed close together, as the reading of one instrument may be affected by the magnetic field of the other.
8. When an ammeter or shunt is to be connected into a circuit, always connect it into the grounded side, if possible.
9. When a voltmeter is to be connected to a circuit, *always connect the leads to the instrument first.* This avoids loose leads which may be "hot". Be sure that voltmeter leads are properly insulated for the voltage to be checked.
10. Instrument, shunts, and leads should always be arranged in such a way that there is no danger of knocking them off the table or tripping over the leads; and if any high voltages are to be measured, the arrangement should be such that no one might accidentally touch the high-voltage equipment.
11. Whenever an instrument is to be connected to a current-transformer secondary, always short-circuit the transformer secondary terminal before the primary is connected in the circuit to avoid dangerously high voltages. *The current transformer secondary must be grounded.*
12. When a potential transformer is to be used, always make sure that the instrument is connected to the secondary, or low-voltage, side. *The potential transformer secondary circuit must be grounded.*

Switchboard Instruments

1. Switchboard instruments should be mounted on panels in accordance with the manufacturer's instructions.
2. Never mount a switchboard instrument on a panel until all other work on the panel is completed, as any pounding or vibration may affect the instrument.
3. The general precautions given under Portable Instruments above, also apply to switchboard instruments.

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Motors

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay $5.00.

READER'S QUIZ

FORMULA FOR SELECTING WATER HEATER

QUESTION 141 I would like information, or a formula on how to select the proper size water heater for a 66 gal. insulated water tank. This tank is in the basement of a 23 patient hospital. I have installed a two kw., but it supplies hot water for only the first two hours in the morning and is lukewarm the rest of the day. I believe the tank is too small for the number of people. They drain it faster than it can heat.—M.Z.

A. TO QUESTION 141. The tabulation below shows the hot water consumption per fixture in a hospital as determined by the American Society of Heating and Ventilating Engineers. In a small hospital not all the fixtures are present and for the sake of illustration I have shown the probable number and type of fixtures in the third column. Reader M.Z. can modify the list to suit the actual conditions.

It is estimated that the actual consumption is 25 percent of the total. Therefore, the actual volume of water to be heated is 0.25 x 92=23 gallons per hour. Each gallon weighs 8.33 pounds and so 8.33 x 23=192 pounds of water is to be heated per hour. The usual temperature range for domestic water heating is from 40°F. to 140°F. or a total of 100°F. One B.t.u. will raise one pound of water one degree Fahrenheit. The heating load, therefore, expressed in heat units is 192 x 100=19,200 B.t.u. per hour. One watt of electrical energy is equivalent to 3.4 B.t.u. per hour. Then, 19,200÷3.4= 5,640 or 5.64 kilowatts of electrical energy is required to heat 23 gallons of water per hour 100 degrees.

A short cut to arrive close to the same answer is to multiply the total gallons of water (4th column) by 6 and divide by 100. Thus: 92 x 6= 552. 552÷100=5.52 kilowatts.

The storage capacity should be figured at 70 percent of the total gallons or in this case 0.70 x 92 or about a 65 gallon tank should be adequate.—A.W.C.

Type of Fixture	Gals. of water per hour per fixture	Assumed number of fixtures	Total gals. of water per hour
Basins, private lav.	2	2	4
Basins, public lav.	6	0	0
Bathtubs	20	2	40
Dishwashers	50	0	0
Foot basins	3	0	0
Kitchen sinks	20	1	20
Laundry tub	28	1	28
Pantry sink	10	0	0
Showers	75	0	0
Slop sink	20	0	0
		Total	92

A. TO QUESTION 141. Your hospital apparently uses approximately 30 gals. of hot water at their peak demand per hour. According to my tables and charts, 1 kw. will raise the temperature of 4.2 gals. water 100 degrees in one hour, using a tank insulated with 3-in. magnesia block and room temperature 72 degrees F. Assume your water is 60 degrees F. when entering the tank, and the desired temperature is 160 degrees F. Thirty gals. divided by 4.2 will give 7 and 1/7th or 8 kw. needed for your job.

I believe your tank is large enough, but would suggest putting on a 3 kw. side arm unit, a 3 kw. immersion unit near bottom and a 2 kw. near top of tank. These of course, to be thermostatically controlled and arranged so the side arm will go off first, allowing the immersion units to maintain the desired temperature.—J.F.

A. TO QUESTION 141. I would suggest installing a 5 kw. heater if the tank has large enough dimension to hold such an element and also has the right size threaded coupling (usually a 2-inch pipe coupling). Otherwise I would cut a hole in the tank and weld a 2-inch coupling or nut from a pipe union and add a 3 kw. element to the present 2 kw. element.

In arriving at this size heater the following assumptions have been made: incoming water temperature is 50°F., lukewarm water is 100°F. and the desired temperature is 150°F.; also I have assumed a 500 watt heat loss at 150°F. Since 1 kw.hr.=3415 B.t.u., 1 B.t.u.=heat to raise the temperature of 1 pound of water 1°F., and 1 gallon water weighs 8.3 pounds; then the water used per hour is approximately:

$$\text{pounds water} = \frac{\text{No. of kwhr} \times \text{B.t.u./kwhr}}{\text{°F. increase}} = \frac{2 \times 3415}{50}$$

$$= 136\#$$

$$= \frac{136}{8.3} = 16.5 \text{ gal./hr.}$$

Considering some heat loss this amount would be lowered to 15 gallons per hour. The heat to raise 15 gallons of water from 50° to 150° is 15 x 8.3 x 100=12,500 B.t.u. Adding a heat loss of 500 watts or 1708 B.t.u., then a total of 14,208 B.t.u. are required to heat 15 gallons of water 100° in 1 hour. Changing to kwhrs, this is $\frac{14,208}{3,415} = 4.16$ kwhr. Consequently a 5 kw. heater element should keep the water at 150° Fahrenheit.—O.S.H.

A. TO QUESTION 141. The question states that the temperature of the water in the tank is reduced to a lukewarm temperature in two hours. If it is assumed that the temperature of the hot water desired

is 150°F. and this is reduced to a lukewarm temperature or 90°F., there is a reduction of 60°F. in temperature in two hours. With a tank capacity of 66 gallons and a starting hot water temperature of 150°F., the amount of hot water used in the two-hour period can be found from the formula

$$Qd = Qh \frac{(Th - Tc)}{Tm - Tc}$$

When Qd=quantity of water at desired temperature
Qh=quantity of hot water
Th=temperature of hot water °F.
Tc=temperature of cold water °F.
Tm=temperature of water desired °F.

solving 66=

$$\frac{Qh\ (150 - 60)}{90 - 60} = 3\ Qh$$

$$Qh = \frac{66}{3} = 22 \text{ gallons}$$

At the end of the two hour period there is 66 gallons of water at 90°F. temperature, consisting of 22 gallons of hot water and 44 gallons of cold water. This means that 44 gallons of 150°F. hot water has been displaced by 44 gallons of 60°F. cold water in a two-hour period or 22 gallons per hour.

To heat 22 gallons of 60°F. water to 150°F. in one hour will require $\frac{22}{4.1}$ =5.4 kw. in heating equipment.

This figure is obtained from the fact that 1 kw. will heat 4.1 gallons of 60°F. water to 150°F. in one hour at a heater efficiency of 90 percent. It can be checked by the formula

$$Kw = \frac{Wg \times Ww \times Sp.H. \times T°r}{B.t.u. \times .90 \text{ eff.} \times H} =$$

where Wg=number of gallons of water
Ww=weight of 1 gallon of water
Sp.H.=specific heat of water
T°r=temperature rise required
B.t.u.=British thermal units 3412 B.t.u.=1 kw. hr.
H=1 hour

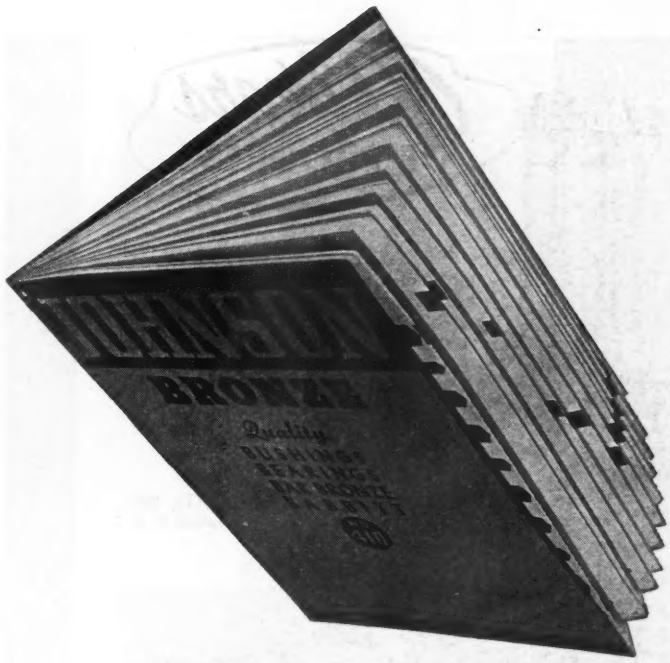
$$kw = \frac{22 \times 8.34 \times 1 \times 90}{3412 \times .90 \times 1} = 5.377$$

—R.E.C.

CURRENT TRANSFORMERS FOR METERING

QUESTION 142. I have a number of switchboard ammeters which were connected to 40 to 1 current transformers. These transformers have been changed to 60 to 1, and the meters do not give me a correct reading. Can someone tell me how to overcome this and make the meters read correctly?—R.M.

A. TO QUESTION 142. To suggest a remedy for the inac-



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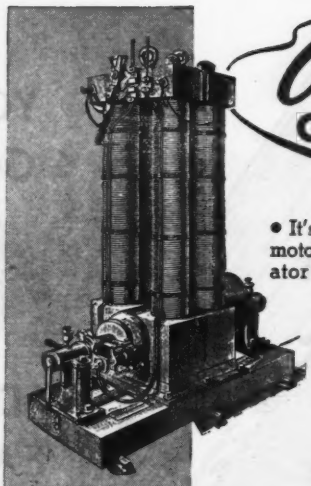

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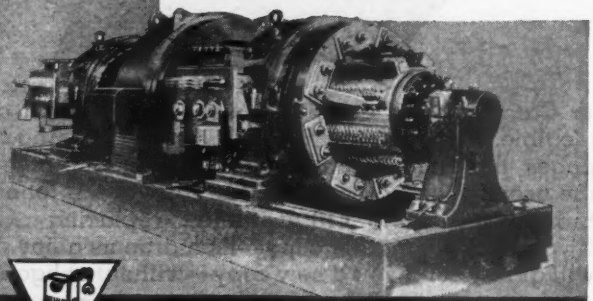

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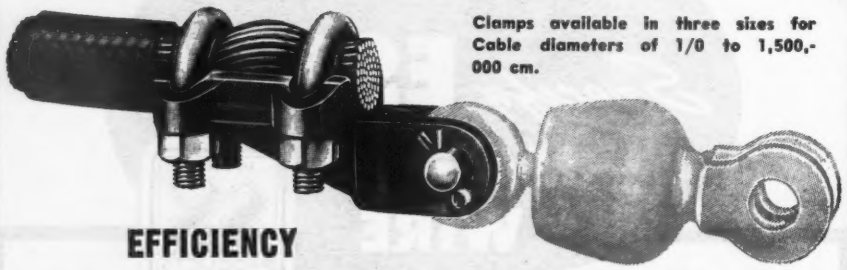

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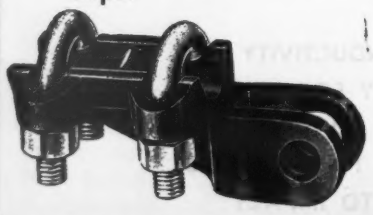

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curate readings obtained, one must consider what might be the cause.

If, when the 60/1 ratio transformers were installed, a heavy current was allowed to flow through the primary of the transformer with the secondary open, it would cause the iron in the transformer to become permanently magnetized after which the meter readings would be inaccurate.

The iron can be de-magnetized by passing about five amperes of a.c. current through the secondary coil having the primary open. Have a variable resistance in the secondary circuit and gradually reduce the current to zero.

Another cause for trouble could be internal meter resistances, but interest here is generally confined to laboratory technique and not the ordinary industrial application.

I have data before me on two ammeters having the same scale. The resistance of one is .0127 ohms and the other .0058 ohms.

Regardless of the ratio of transformation, if we assume that there is a value of current in the line which should cause 10 amperes to flow through the meter, the voltage drop across the terminals of one meter would be .0127 times 10 or .127 volts. Ten amperes through the other meter would cause a voltage drop of .0058 times 10 or .058 volts.

It is evident that to obtain the same degree of accuracy the same transformer cannot be used for both meters. If you have a transformer designed for the meter having a resistance of .0127 ohms and connect it to the meter having .0058 ohms, the readings will be slightly different. Here again it must be pointed out that for the ordinary commercial usage, this difference in reading would usually be negligible.

A makeshift way of correcting the trouble in this case would be to insert a non-inductive resistance having a low temperature coefficient in the secondary circuit to increase the voltage drop to .127 volts which would be the correct voltage drop to cause the meter to read 10 amperes.

In this case you would have to cause a drop through the resistance of .127 minus .058 or .069 volts. With 10 amperes flowing, the resistance necessary would be .069/10 or .0069 ohms. When corrected for one value of current it would be corrected for all values. Naturally the resistance should be able to carry the maximum current that the meter can carry.

If the correct readings were obtained when the 40/1 ratio transformer was used, both the 40/1 and 60/1 ratio transformers could be connected to their respective meters and in the same supply line as a means to calibrate

the 60/1 ratio meter. If the meter connected to the 40/1 transformer reads 10 amperes you would insert resistance in the 60/1 transformer secondary circuit until its meter read $6\frac{2}{3}$ amperes.

However, I would certainly contact the manufacturer of the instruments for additional information and recommendations overlooked herein.—B.A.S.

A. TO QUESTION 142. To obtain the correct readings of the switchboard ammeters, either the scale must be changed to correspond to the ratio of the new current transformers or a new multiplying constant applied to the present scale.

Current transformers usually have a secondary current rating of 5 amperes. A current transformer with a ratio of 40/1 will have a secondary current rating of 5 amperes and a primary current rating of 40 times 5 equals 200 amperes. If the ammeters in use with current transformers having a 40/1 ratio are direct reading, they would have a full scale reading of 200 amperes and a multiplying constant of 1. Any change of values on the scale would be directly in proportion to the change in the current transformer ratio. When used with current transformers with a ratio of 60/1, the ammeters will have a full scale value of $\frac{60 \times 200}{40} = 300$ amperes.

The scale of the ammeters can be changed by making the values $1\frac{1}{2}$ times their present value, that is, 100 amperes would be changed to 150 amperes, and 200 amperes would be changed to 300 amperes.

The simplest way to obtain the correct scale values would be to change the multiplying constant from 1 to 1.5. This new multiplying constant is obtained from the ratio of the current transformer 60:1::40:1 = 1.5.—R.E.C.

A. TO QUESTION 142. Current transformers for metering are usually wound with a five ampere secondary. The question does not state the full scale reading of the meters, but based on the statement that they were connected to 40 to 1 ratio transformers we will assume they are 200 ampere meter scales. If the transformer ratio is changed to 60 to 1, this means that when five amperes are flowing in the meter 300 amperes are flowing in the line.

In other words, full scale deflection will be obtained at 200 amps. primary current with the 40/1 C.T. while 300 amps. must flow to get full scale deflection using the 60/1 C.T.

If the present scale readings are multiplied by a constant of 1.5 the reading will be correct.—D. S. V.

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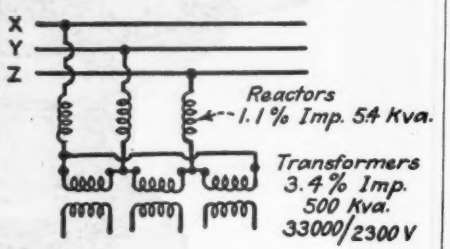
Can you ANSWER these QUESTIONS

QUESTION L6 We have several banks of transformers all of which are parallel and connected delta-delta. One bank of three 500 kva. units have an impedance of 3.4 percent for each unit. In order to parallel this bank with other banks



having a higher impedance a reactor is installed in each phase as shown in the diagram. If due to failure of one of the 500 kva. units a spare 1000 kva. unit having an impedance of 4.6 percent were used to complete the delta, how would it be connected?—J.A.H.

QUESTION M6 Can your readers tell me how to energize a selsyn receiver without disturbing other receivers or the sender on the same system? Heretofore I have always stationed a man at each of the several units to hold them from spinning while the entire system was energized, but I would like to know how this could be made a one man job.—G.I.S.

QUESTION N6 Have a busway 500 feet long; that is metal case with busbar conductor inside, all sealed in and the case grounded. This developed a fault about two-thirds of the way from the supply end and burnt off the whole busway. Now what caused this trouble? We believe it was something like a faulty insulator, loose connection, a piece of loose metal in the busway that would cause a ground or short circuit.

This busway is 400 ampere, 3 phase, 480 volt. We were informed by an engineer that this was not uncommon and was probably caused by static. His explanation was that the busbar became highly charged with static, jumped across the insulator to the grounded metal casing, and the 480 volt current followed the arc path to ground. There is a great deal of static near this busway. In an effort to stop this trouble, a high resistance leak was put on each busbar to ground of about 10 watts each. This is supposed to drain off any static that might otherwise accumulate. I would like very much to know if other *Electrical Contracting* readers have had or heard of similar experiences and what was done to remedy the situation.—W.L.C.

PLEASE SEND IN YOUR ANSWERS BY SEPTEMBER 1

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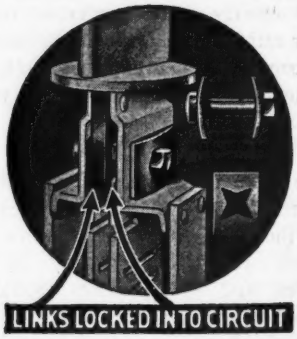
WARE HI-LAG



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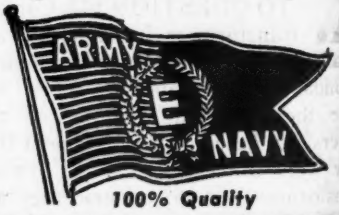

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• These revolutionary Drill bits are saving man-hours on the drilling of anchor, pipe and conduit holes in masonry and concrete. They are quieter, hold their edge longer and are easily redressed. Can be used in any rotary drill (slow speed).

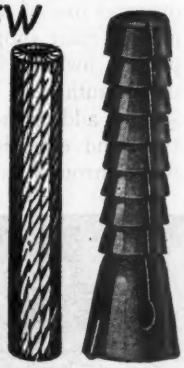
Available in sizes from 3/16 in. through 1⅛ in. diameter (graduated in 1/16 in. sizes) all having a maximum ½-in. shank.

•

BUSH WOOD SCREW HOLES *with* PAINE *WOODSCREW ANCHORS*

• Also for Fastenings in brick • Tile • Marble • Slate and Wood Furring.

•



868 Fiber Type 858 Lead Type

You simply place anchor in hole, insert woodscrew and tighten. NO setting tool is needed. Anchor expands uniformly as screw is tightened to assure a firm fastening and a workmanlike job. Available on low priority in a wide variety of sizes.

Ask your Supplier TODAY or write for complete catalog of PAINE Fastening and Hanging Devices: "Sudden Depth" Drill Bits, Woodscrew Anchors, Spring Wing Toggle Bolts, Conduit Clamps, Lead Expansion Anchors and other essential items.

THE PAINE CO.

2961 Carroll Avenue Chicago 12, Ill.

Offices in Principal Cities

PAINE FASTENING and HANGING **DEVICES**

Wiring Diesel Electric Cranes

[FROM PAGE 51]

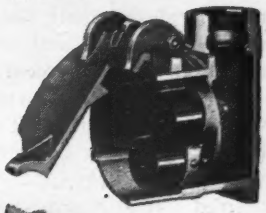
sectionalized. Leads to the grids on the roof were enclosed in a section of fiber duct with slots in the bottom for each lead connection to a grid post. In general the crane roof and floor sections were packed as separate units with all wiring and lighting intact. The same was true for the crane sides, operator's cab, distribution cabinet, boom and other sections.

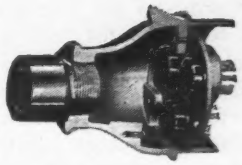
To simplify the job of reconnecting the wiring system W. G. Poole, partner in the Gulf Electric Co., designed a simple coding method which was closely followed. A number was stamped on each solderless lug and a corresponding number stamped on a metal clip fastened around the cable entering the lug. A similar numerical coding system was used for conduit and boxes at various junction points. Thus, reassembly of the electrical system was merely a matching of numerals. Manufacturers' wiring diagrams, furnished with the equipment, were coordinated and shipped with the crane sections.

Poole's original plan of shop prefabrication of conduit sections and other items to simulate a mass production system had to be abandoned in favor of a purely field fabricated installation. This was primarily due to the slight variation in available steel sizes used on different units (since "standard" sizes were not always available) which, although they had no material effect on the structural strength and construction of the crane, were sufficiently different to preclude pre-fabrication of conduit sections for all units. Hence, as much power driven equipment as possible was sent to the crane fabrication shop to speed up the electrical work.

Installation of the electrical equipment ran smoothly and kept pace with crane production. There were no hitches. Gulf Electric furnished all conduit, wire, lighting equipment and accessories — except heavy switchboards and motors which, because of the specialized nature of their application, were bought direct from the manufacturers—and was responsible for the installation of the complete electrical system. Close cooperation between fabricator and contractor made possible the completion of about four cranes per month—an accomplishment for which the Turney Manufacturing and Engineering Company was cited.

MULTIPLE UNIT plugs and receptacles





3 unit sectional view.

1, 2, 3, 4, 6, 8 pole interchangeable contact units.

Any combination, 2 to 32 poles, for thermocouples, sound equipment, remote controls, lighting and motor wiring. Interchangeable contact units—1 to 8 poles—can be assembled in 2, 3, or 4 unit plug shells and receptacle housings to make any desired combination of circuits. Equipment can be arranged with the protected female contact units in either plug or receptacle, for safety in line side of the circuit. Ground protection is provided. A full line of plug shells, cable connectors, and standard receptacles allows the widest range of assembly combinations to meet any needs. Write for Pylet catalog giving complete specifications.

THE PYLE-NATIONAL COMPANY

1344 N. Kostner Avenue, Chicago 51, Illinois

MOTOR SHOPS

MOTOR SHOP TESTING EQUIPMENT

The Maintenance Company, Inc., of New York City, who do primarily elevator and motor maintenance work in addition to electrical construction, takes pride in their testing facilities which are flexible and meet all testing requirements 100 percent.

The main testing switchboard consists of three panels. The one to the left is the direct current panel, providing either 110/220 v. current as desired. It also provides low voltage of from one to ten volts for use in making commutator bar to bar (armature coil by coil) tests, with the help of the millivoltmeter at the upper center of the panel. The low voltage is obtained from the motor-generator shown on the stand at the left of the panel. The instruments across the top of the panel are respectively for low voltage amperes, 110 volt and 220 volt system amperes, and for 110/220 volt system volts.

The center panel is for high voltage alternating current testing of insulation. Fifteen hundred volts may be obtained from this panel, which provides a very satisfactory test for 220- and 440-volt windings; 440-volt polyphase current is also obtained from this panel, by means of the two transformers seen at the far left under the motor generator unit.

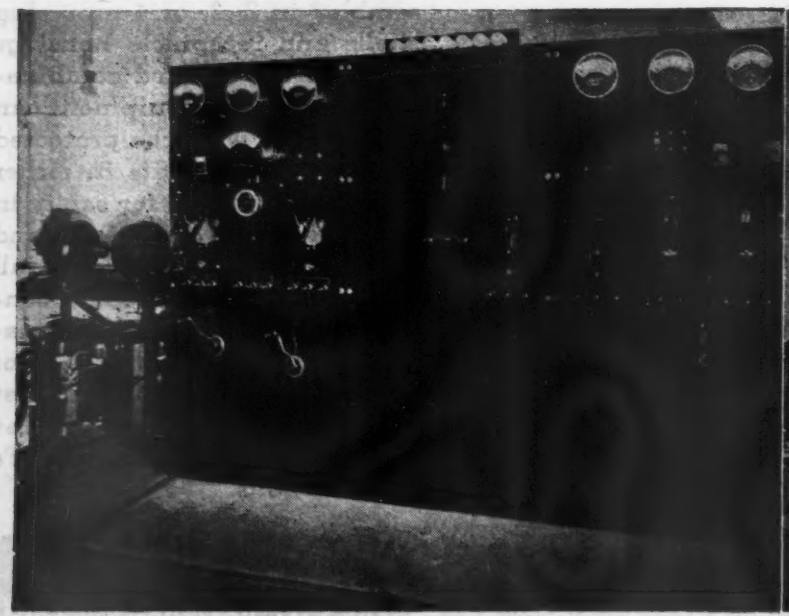
The third panel is for 220 or 110 nominal volts alternating current. Either three-phase, single-phase or two-phase current is obtained, with instrument readings in volts, amperes and watts or kilowatts.

Connection to external equipment under test is made by means of cables leading from the spinner type connection terminals seen across the bottoms, and at the edges of the panels, except that the high voltage test cables are plugged into safety-type receptacles. As will be noted, all switches are of the "dead front" type.

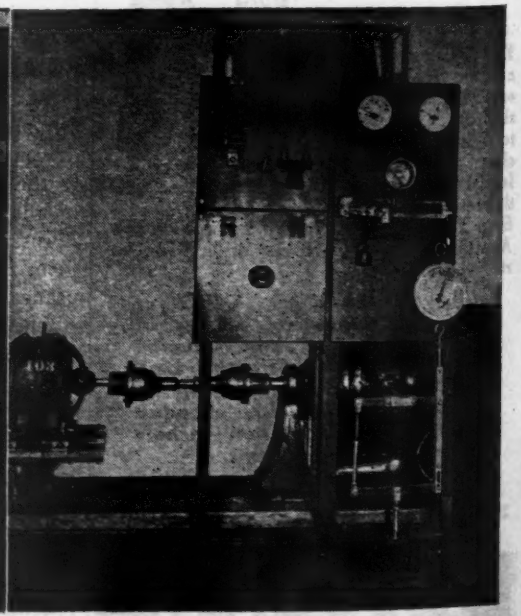
The second illustration shows the dynamometer testing equipment and panels for measuring torque and power developed by a motor. The motor under test is mounted on the slotted testing table at the left, the table being arranged to be raised or lowered to bring its shaft in line with the shaft of the generator shown behind the panel at the right. The motor is then coupled to the generator by means of the ball-and-socket type flexible couplings shown. The generator field frame is cradled on its armature shaft so that the frame can swing between fixed limits. The magnetic pull exerted by the generator armature on its field tends to rotate the field frame, the latter being restrained by the scales shown in front of the right-hand panel. By loading the generator through the adjustable resistance shown above the panels, until full load is thrown on the motor, as determined by reading the instruments, the full load torque can be determined by observing the number of pounds required to hold the generator field frame centered and stationary. In testing alternating-current motors the "pull-out" torque may be determined by loading the generator until the motor speed dies down. This determines the maximum starting torque of the motor, as well as the full-load running torque.

COMBINATION SOLDERING AND COOLING TABLE

Down in Nashville, Tennessee, the Tennessee Electric Motor Service operates one of the most efficient small motor repair shops in the field. Enterprising owner H. E. Grant, a recognized authority in the field, is constantly adding new "kinks" that save time and expedite the flow of repair work through the shop.



***MAIN TESTING SWITCHBOARD** consisting of three panels; one for 1 to 10 volts and 110/220 volt direct current, one for 1500 volt h.v. tests and polyphase 440 volts for running tests, and the third for 110/220 volt polyphase running tests.*



***DYNAMOMETER TESTING EQUIPMENT** to measure torque and horsepower ratings of motor. Loading resistors can be seen atop switchboard, and scales in front of panel.*

CROCKER-WHEELER MOTORS for ALL INDUSTRY

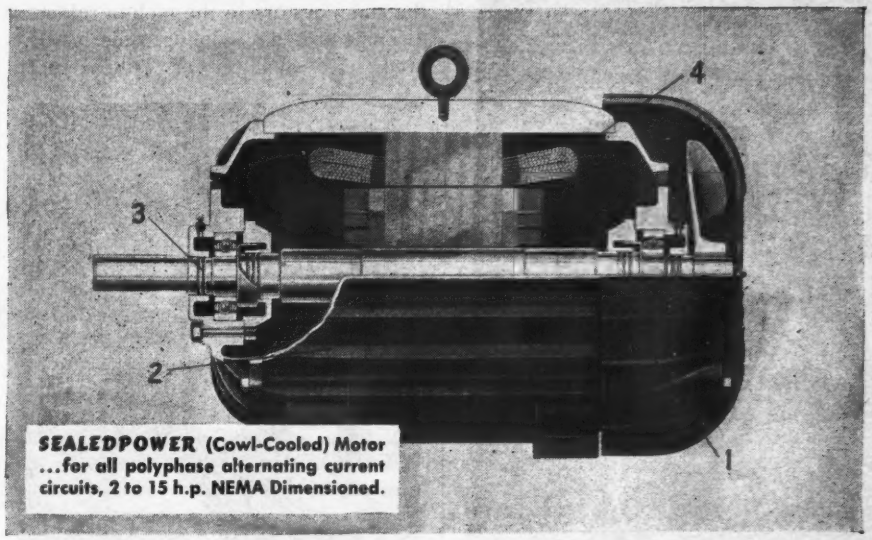
FEATURES

1. Totally Enclosed Cowl-Cooled type minimizes fire hazard, resists corrosion. Protects against acid or alkali fumes, splashing or dripping corrosive liquids, air-borne moisture, steam, corrosive gases, conducting dusts, metallic chips, lint, etc.

2. Fin Type single shell construction, with all surfaces exposed and a readily removable fan shroud, gives non-clog ventilation. Easy to clean...foreign matter passes over the surfaces of and not through the motor.

3. Patented GROOVSEAL antifriction bearings — no greasing needed for at least a year—minimizes maintenance. Seal permits use of softer grease, for better lubrication and longer bearing life. Water-tight — Dust-tight — Air-tight.

4. Vacuum Impregnation with high grade insulating varnish seals out foreign matter and moisture from each individual coil... makes windings a homogenous mass... reduces hot-spot temperature and lengthens insulation life. Adherence of varnish prevents vibration of wires inside or outside of slot.



SEALEDPOWER (Cowl-Cooled) Motor ...for all polyphase alternating current circuits, 2 to 15 h.p. NEMA Dimensioned.

SEALEDPOWER...Industry's Most Trouble-Free Motor

because...

YOU CAN DEPEND on a Crocker-Wheeler field engineer to recommend the power equipment *you need*. Behind him is *56 years* of our company's experience...*56 years* of continuously developing facilities and skills *exclusively* in the power field.

Crocker-Wheeler, one of the leading companies in the field, specializes SOLELY in the design manufacture and application of electric power equipment.

As power SPECIALISTS, Crocker-Wheeler field engineers know the power needs of your industry—of your particular production processes. Call in one of our experienced engineers for specific advice on motors, generators, control and couplings . . . no obligation.

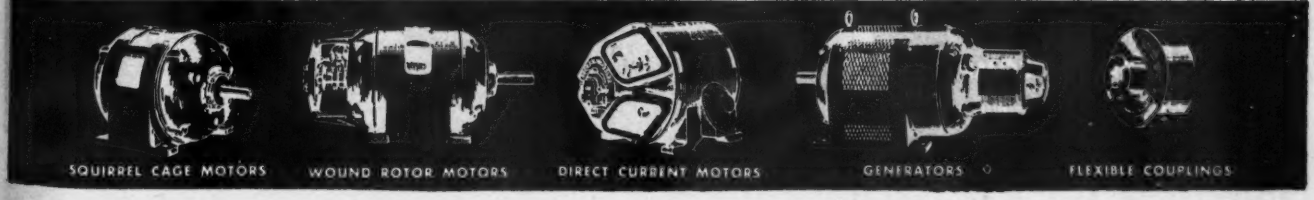
JOSHUA HENDY IRON WORKS

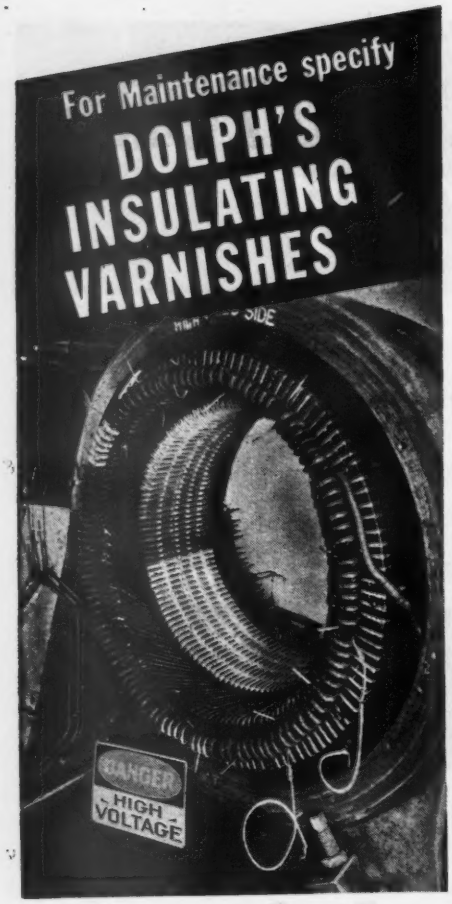
CROCKER-WHEELER DIVISION

ESTABLISHED 1856

AMPERE, NEW JERSEY

Branch Offices: BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • WASHINGTON • LOS ANGELES





For over a third of a century, motor repairmen have continued to specify DOLPH'S Insulating Varnishes for maintenance of electrical equipment. In the DOLPH Line, there are insulating varnishes formulated to do a better job. Some of the baking grades are excellent for large armature and stator coils which are treated in varnish prior to their insertion in the slots. Because of the high degree of flexibility which these varnishes possess, the coils may be stretched into the slots without rupturing the insulation.

There are also other insulating varnishes of the air drying type which are designed to provide extra protection to windings, commutator ends, string bands, etc. of units operating under severe conditions..

Dolph's

JOHN C. DOLPH COMPANY

Insulating Varnish Specialists

168-A Emmet St., Newark, New Jersey

One of these innovations is located in the commutator soldering department where he has used the heat conductivity of metal as a media for quickly cooling the soldered armature commutators. A combination table is used with the solder bench only 16-inches high to bring the level of the gas fired solder pot even with the 33-inch high cooling table. Armature supports permit rotating the edge of the commutators in the molten solder.

The top of the cooling table is covered with a sheet of ¼-inch sheet

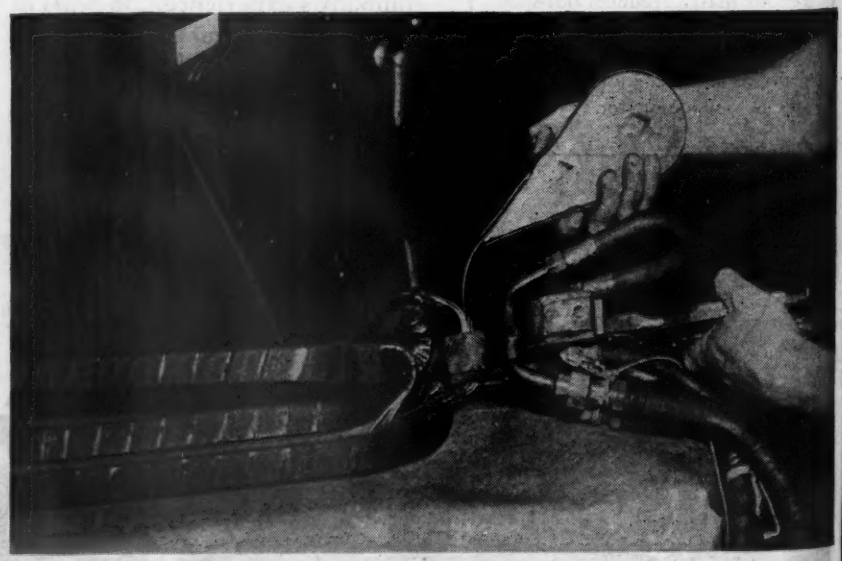
COOLING TABLE with metal top holds armatures in upright position after they have been soldered.

iron. A number of holes are drilled through the iron and table top to accommodate the soldered armatures which are inserted commutator down. The metal top helps cool the commutators more quickly and also takes out the buckle that sometimes occurs when vertical face commutators are soldered. After the armatures are thoroughly cooled they are placed on a storage shelf underneath the table.

SOLDER DISPENSERS SAVE WEIGHT AND PREVENT CONTAMINATION

The two easy-to-make dispensers shown in the accompanying photos simplify the feeding of solder in silver-alloy brazing work and prevents waste. The one dispenser is for ribbon type solder and is a flat metal case containing two rollers, one in the circular portion and another near the point. The silver solder is thumb-fed over the second roller and out the point of the dispenser through a slot in the edge of the case. As this strip became shorter it would get too hot to handle and the workman would drop it and get another piece. The dispenser can be loaded quickly with sufficient solder for a large number of brazes, and permits the operator to keep his hand far enough from the work to avoid being burned.

PENCIL-TYPE dispenser is used for small round solders which can be pulled out as needed.

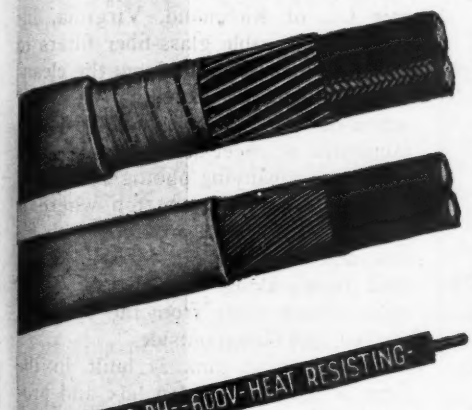


RIBBON-TYPE silver solder dispenser used for resistance-brazing coil terminals.

HAZARD CABLES

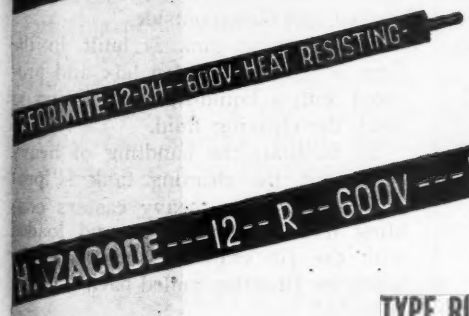
to fill many needs...

The wide range of cables made by Hazard provide for many problems met in the course of the day's work. Here are examples, designed for specific requirements and built to withstand a number of severe conditions. Hazard research and experience are at your command to help in choosing the right cable for the right job.



HAZARD SERVICE CABLES FOR SERVICE DROPS AND ENTRANCES

Type SE (ABN and UBN) cables, with synthetic rubber insulation, prevent current diversion, eliminate conduit and extra fittings and are architecturally harmonious. Type SD is efficiently designed for service drops. Sizes 12 to 2 inclusive, 2 and 3 conductors.



HAZARD PERFORMITE TYPE RH BUILDING WIRE IS SUPER AGING

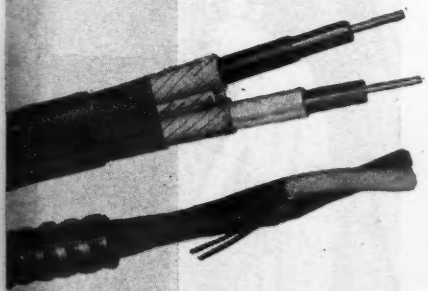
This heat-resistant long-life wire is free stripping and easily installed. Because of its greater carrying capacity, it saves strategic copper. Recommended for branch feeders and general light and interior wiring. All sizes available.

TYPE R HAZACODE WIRE

exceeds all minimum requirements of N.E. Code and is recommended for general interior building wiring; has a sturdy, long lived, flameproof braid covering, and is readily installed.

TYPE RL HAZACODE LEAD ENCASED

is particularly useful now for damp locations while Type RW is unavailable.



HAZARDEX NON-METALLIC SHEATHED CABLE AND HAZARD ARMORED CABLE

for interior wiring are both obtainable. These familiar types of cable are made to exacting Hazard quality standards.

TYPE K FABRIC COVERED CORD—an approved cord for ordinary use.
TYPE KK HAZARD SPIRALWEAVE CORD a portable cable for heavy duty.

Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

HAZARD

ELECTRICAL WIRES AND CABLES

ARMY E NAVY

3648

Mr. Tops, the Paragon symbol of top quality.

TOP QUALITY POULTRY HOUSE TIME CONTROLS

Model PS

TO insure Fall delivery place your order now for Paragon Top Quality Poultry House Time Controls. Paragon "PS" models are designed for both morning and evening lighting, with dimming period for roosting. The Paragon Model 301 is designed essentially for morning lighting only. It is a heavy duty, industrial type time switch adaptable to poultry house lighting. It is truly a superior instrument of high quality and low price. All Models are synchronous motor operated and available on AA5 or better.

Model 301

Send for Authoritative Bulletin

Paragon has prepared a 4-page, 2 color bulletin containing authoritative information relative to poultry house lighting control . . . location of lights, selection of light control switches, etc. It summarizes the recommendations of leading poultry authorities and gives complete data regarding the wide range of Paragon poultry house time switches. Send for a supply to distribute among your dealers and power companies.

PARAGON ELECTRIC COMPANY
710 Old Colony Building
Chicago 5, Illinois

Paragon Chicago
BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1905

The pencil-type solder dispenser which prevents contamination of solder from handling and dirt, was made of a piece of methyl methacrylate resin tubing. The brass nozzle is cemented into the body of the tubing with a press fit. Before loading the solder into the dispenser, it is form wound on a drill rod in a bench lathe. The operator pulls the solder from the dispenser with pliers as it is needed. Both types are used at the General Electric plant for various soldering operations.

AIR FILTERED FROM CLEANING BOOTH

To protect the neighbors' Monday morning wash, Electric Motor and Repair Co. of Richmond, Virginia, installed replaceable glass-fiber filters to clean the dirt-laden air from the cleaning booth before expelling it to the out-of-doors. The cleaning booth is fabricated of sheet steel and is shown in the accompanying photograph. It is built to a gable at the top where is located a large vent provided with filters, and a suction fan. The cleaning fluid fumes along with the dirt-laden air is drawn away from the operator, filtered, and blown outside.

The cleaning tank is built in the form of a large wooden box and provided with a liquid-tight tin lining to catch the cleaning fluid.

To facilitate the handling of heavy equipment, the cleaning tank is provided with large, heavy casters enabling it to be pulled out and loaded with the jib crane, pushed into the booth for cleaning, pulled back out and unloaded.

CLEANING BOOTH provided with suction fan and vent filter for cleaning the air. Switch at side lights lamps in booth and starts fan. Note casters on cleaning tank.

WHEN YOU NEED

D-C Motor Controls

CONSULT WESTINGHOUSE BUYING DATA (NEW CATALOG 7000)

With the new Westinghouse Buying Data, you can select and purchase the proper motor control in half the time.

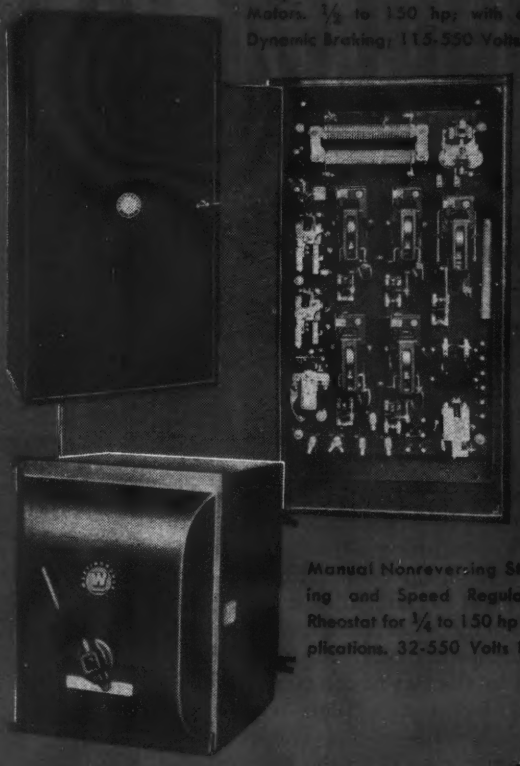
Data, as presented, is striking in its newness. It's easier to read, easier to understand, and easier to use than any published previously by any manufacturer.

Chances are—if you are a buyer of motors and controls—that you have already received a copy of this new Catalog 7000 by mail. However, if you have not received your copy, write, wire or phone your nearest Westinghouse district office. (Requests will be filled through district offices only—no mailing from Westinghouse headquarters at East Pittsburgh.) J-21309

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Motor Control



Heavy-Duty Reversing D-C Magnetic Timestarter for Constant and Adjustable Speed Motors. ½ to 150 hp; with or without Dynamic Braking; 115-550 Volts.

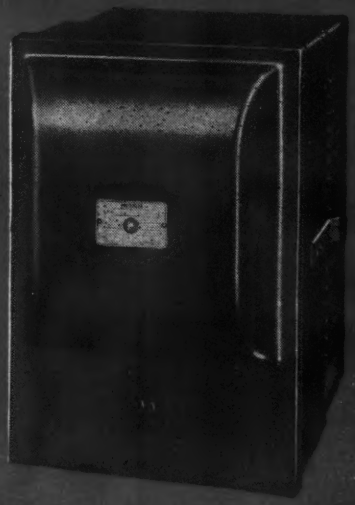
Manual Nonreversing Starting and Speed Regulating Rheostat for ¼ to 150 hp Applications. 32-550 Volts D-C.

Reversing Drum Controller for Crane and Hoist Service, 1 to 50 hp; 115, 230, 550 Volts D-C.

Nonreversing "De-ion" Linestarter for Compound-Wound D-C Motors. 1½ and 2 hp; 115 and 230 Volts.

Heavy-Duty Nonreversing D-C Magnetic Timestarter for Constant and Adjustable Speed Motors, with or without Dynamic Braking. ½-150 hp; 115-550 Volts.

D-C General Purpose Nonreversing Magnetic Timestarter for Time Limit Acceleration. ½-10 hp; 115 and 230 Volts.



Reversing "De-ion" Linestarter for Compound-Wound D-C Motors. 1½ and 2 hp; 115 and 230 Volts.

MODERN LIGHTING

LIGHTING AIDS INSPECTION OF TARPAULINS

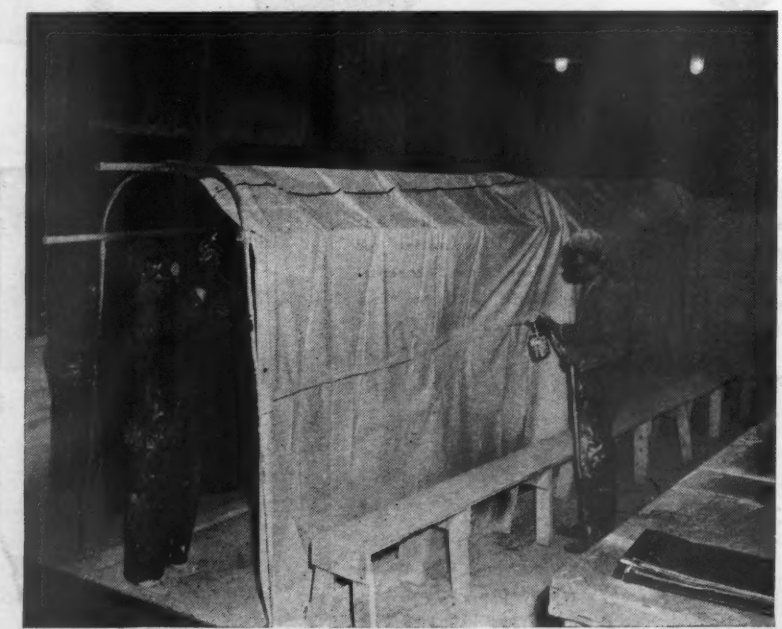
An explosion-proof installation of incandescent lighting providing 20 foot-candles of general illumination has proven to be a solution to the problem of inspecting waterproofed tarpaulins at S. Buchsbaum & Company, Chicago, Illinois.

The tarpaulins measure 15 feet by 20 feet and have waterproofing applied to both sides; olive green on one side and white on the other. Light had to be provided to readily detect and repair breaks in the waterproofing. The main difficulty of the operation was occasioned by the size of the tarpaulin and by the fact that a slight separation between threads of the fabric is not necessarily a break in the waterproofing.

The most efficient method of inspection was found to be a visual one with a light source of some sort behind the opaque tarpaulins. Thus light rays penetrating the material would make breaks readily noticeable and the degree of break could be determined by the intensity at that point.

To speed production, an iron frame was constructed in the form of an arched tunnel 6 feet 6 inches high, 20 feet long, and 4 feet wide. The frame was placed in a lighted room having approximately 20 foot-candles of general illumination. Too much light on the outside of the frame was undesirable as small separations of the fabric threads appear as pin holes and may be confused with actual defects in the water-proofing or material. The tarpaulin was placed over the frame with the green side in. This excludes all light from the tunnel except that which may enter the ends. Two or three operators work on the inside of the tunnel and one or two on the outside. Small imperfections are detected and sprayed by the workers on the inside while larger ones may also be sprayed on the outside. The outside operator's attention is obtained by shaking the fabric at the point of break.

GREEN SIDE of tarpaulin is placed in so that light is excluded from interior. Light rays then penetrate breaks which are readily detected.



IRON FRAME supports large tarpaulins for inspection of breaks in waterproofing. Inside spray operators detect breaks and both cover the break area with spray.

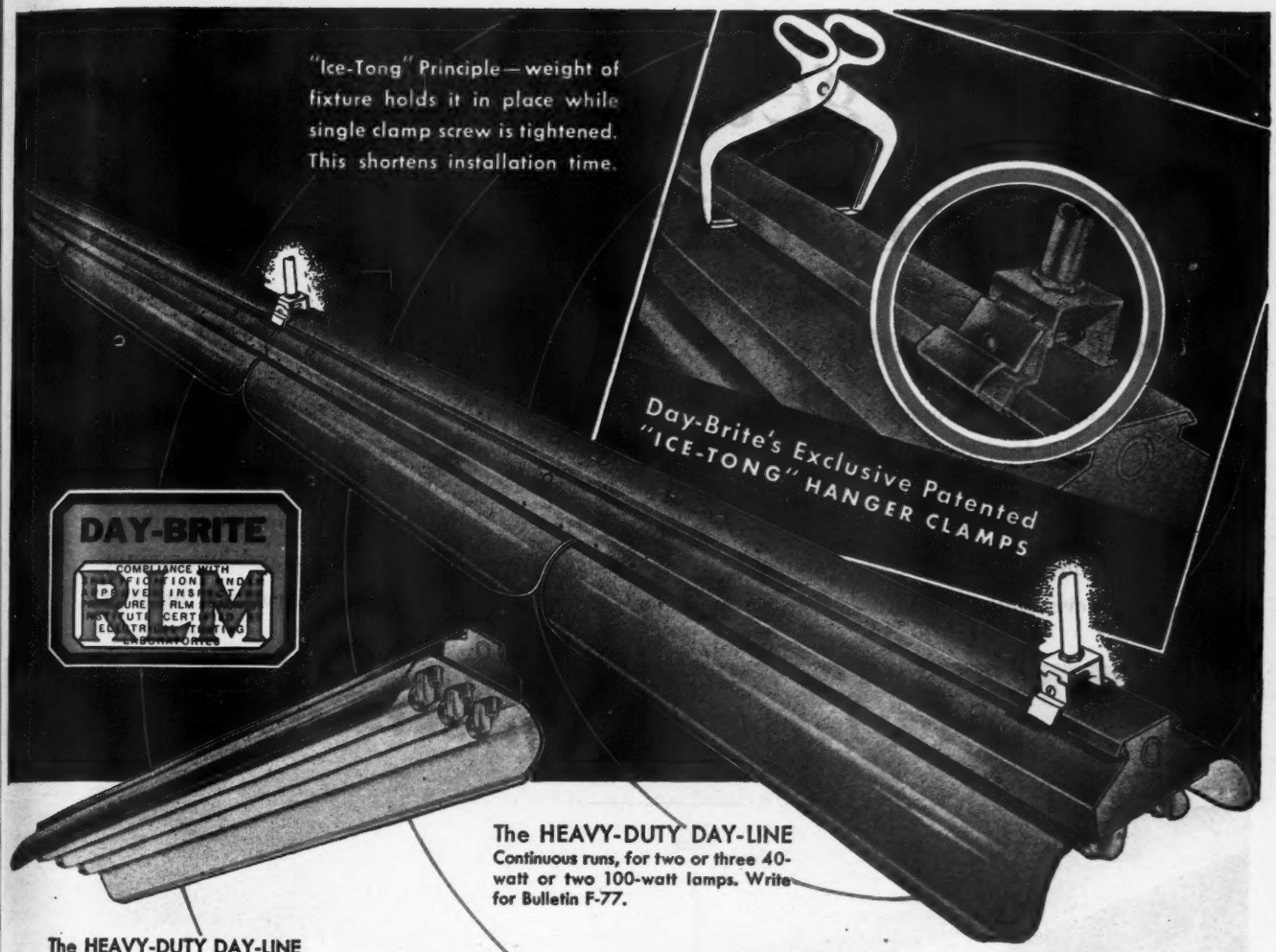
COLD CATHODE LIGHTING IN A TRAIN TERMINAL

When the management of the Union Station, St. Louis, Mo., one of the busiest and most important rail terminals in the country, remodeled and redecorated the Midway (train concourse), they decided to install a modern lighting system. Their choice of a lighting unit was guided by the following factors:

1. The physical dimensions of the concourse (two blocks long).
2. Sufficient illumination for the safe movement of the vast crowds of travelers using the station.
3. Long lamp life—to reduce to a minimum the maintenance requirements, since maintaining fixtures at a high mounting height in a crowded area is always a problem.
4. A stream-line appearance to blend with the remodeled concourse.

A high voltage cold cathode system was chosen to meet the above requirements. Designed and manufactured by the Federal Brilliant Company, St. Louis, the installation consists of 1,188 feet of lighting divided into two rows, each 594 feet long. Each row consists of a continuous porcelain enamel steel reflector containing six lines of 20 mm., 3,500 degree white tubing made in standard 6-foot lengths. The two rows of reflectors are mounted on 20-foot centers, 24 feet above the floor.

A total of 99, 60-milliampere, 15,000-volt H.P.F. transformers operate the entire system with each transformer feeding 12 lengths (72 feet) of tubing. Primary voltage is 230. The 7,128 feet of cold cathode tubing in the installation has a total lumen output of approximately 1,140,480 lumens. Current


"Ice-Tong" Principle—weight of fixture holds it in place while single clamp screw is tightened. This shortens installation time.
Day-Brite's Exclusive Patented "ICE-TONG" HANGER CLAMPS
DAY-BRITE
RLM

The HEAVY-DUTY DAY-LINE
Continuous runs, for two or three 40-watt or two 100-watt lamps. Write for Bulletin F-77.

The HEAVY-DUTY DAY-LINE
Single unit, for two or three 40-watt or two 100-watt lamps. Write for Bulletin F-77.

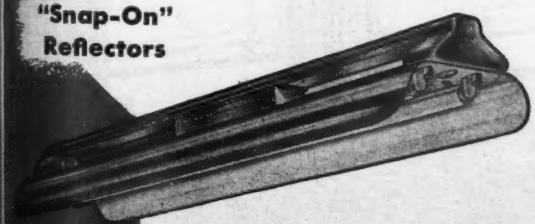
Two Effective Types of Industrial Lighting Fixtures

Heavy-duty RLM Day-Line Industrial Fixtures are again available with porcelain enamel reflectors—plus DAY-BRITE'S exclusive "ice-tong hangers" which assure low-cost installation speed. With these unique hangers, it is unnecessary to spot exact center locations. For any type of suspension, they are merely positioned parallel with the length of the fixture channel.

The Day-Line Series "W" and "WS" Industrial Fixtures are furnished with either porcelain or non-metallic reflectors. Both are RLM approved. (See description below.)

Get full information on all types of Day-Brite Fluorescent Fixtures. Contact your nearest Day-Brite Engineering Representative, or write for descriptive Bulletins.

DAY-LINE "W" and "WS" Series with "Snap-On" Reflectors



The "W" Series—non-metallic reflectors with Day-Brite's exclusive "Super-White" enamel.... The "WS" Series—porcelain enamel reflectors.... Both types available for single-unit installation in two 40-watt, three 40-watt and two 100-watt models.... Write for Bulletin F-76.

DAY-BRITE LIGHTING, INCORPORATED
5434 Bulwer Avenue . . . St. Louis 7, Missouri

DAY BRITE
The Sign of Quality
Look for this Label

Day Brite
LIGHTING FIXTURES

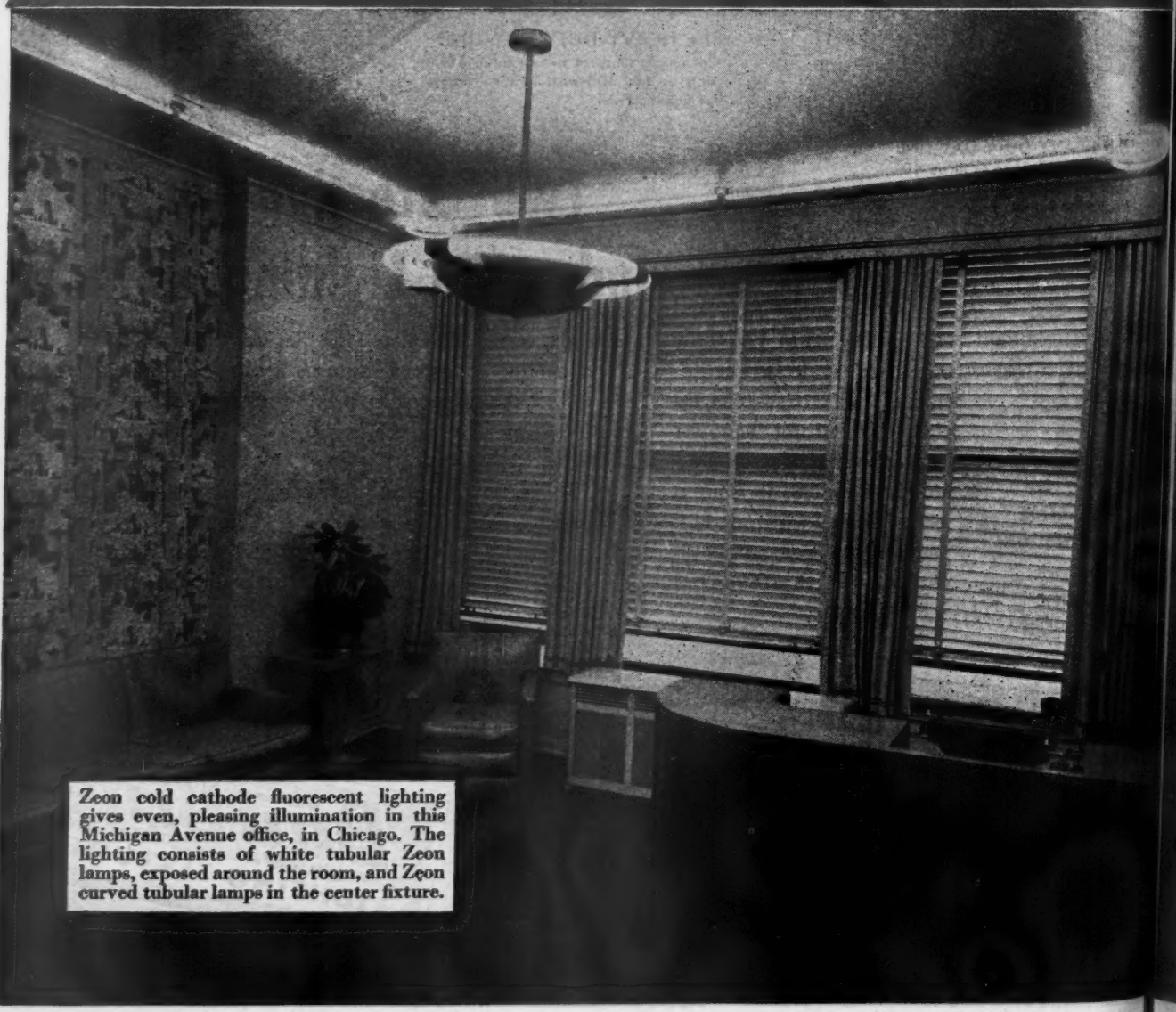
Nationally distributed through all leading electrical supply houses

How to get long life... lower maintenance cost in

THERE ARE TWO KINDS OF FLUORESCENT LIGHTING

The older, more common kind of fluorescent lighting is *hot cathode; cold cathode* is the newer type, of which Zeon fluorescent lighting is the outstanding example. Both are a great improvement over incandescent lamps—they give more even, diffused light . . . better illumination . . . three or four times as much light per watt. But *cold cathode* has some marked advantages, which in some installations are of supreme importance. Perhaps the most important advantages are the long lamp life and low maintenance characteristic of cold cathode lighting.

Why COLD CATHODE is preferred



Zeon cold cathode fluorescent lighting gives even, pleasing illumination in this Michigan Avenue office, in Chicago. The lighting consists of white tubular Zeon lamps, exposed around the room, and Zeon curved tubular lamps in the center fixture.

Fluorescent LIGHTING INSTALLATIONS

HERE IS THE DIFFERENCE BETWEEN THE TWO KINDS

Efficiency: lumens per watt of hot cathode is slightly higher than that of cold cathode; both outputs are much higher than that of incandescent lamps. *Lamp Life:* hot cathode lamps last two or three times as long as comparable incandescent lamps; cold cathode lamps from 10 to 30 times as long. *Auxiliaries:* hot cathode requires several auxiliaries; cold cathode only one auxiliary—a transformer; series circuits, with much less wiring. *Flexibility:* hot cathode made in straight lamps, fixed lengths, fixed light output; cold cathode lamps available in standard units or in any length, unusual shapes; light intensity variable by controlling current.

LONGER LAMP LIFE

means fewer changes of lamps, less inconvenience and trouble with burned-out lamps.

LOWER MAINTENANCE COST

because lamps seldom need replacing; fewer auxiliaries, less wiring to make trouble.

INSTANT STARTING

without overload; cold cathode lamps start instantly on their operating voltage.

CONSTANT LIGHT FLOW

with no flicker; minimum of shadow; maximum of even, diffused illumination.

FEWER AUXILIARIES

Only transformer and minimum of wiring are needed with cold cathode lighting.

GREATER FLEXIBILITY

in shapes, sizes, colors, and output; standard units or custom-built installations.

Long life and low maintenance are important advantages of cold cathode fluorescent lighting systems. The exceptionally long life of Zeon tubular lamps means that lamp replacement occurs only at long intervals. The fact that cold cathode operates with fewer auxiliaries and a minimum of wiring leaves fewer spots where any trouble can develop. As a result, far less maintenance is required; maintenance costs are much lower; manpower is used more effectively.

Zeon cold cathode fluorescent lighting offers high levels of even, practically shadowless illumination; greater flexiblity in design and installation; exceptional economy in operation. In designing systems for immediate installation, *specify Zeon;* in blueprinting for post-war installations, *plan to use Zeon.* Ask Federal Electric Company, Inc., for suggestions and help in solving your lighting problems.

FEDERAL ELECTRIC ZEON COLD CATHODE FLUORESCENT LIGHTING

LIGHTING DIVISION

FEDERAL ELECTRIC COMPANY, INC.

8700 SOUTH STATE STREET, CHICAGO 19, ILLINOIS • TELEPHONE VINCENNES 5300
225 NORTH MICHIGAN AVE., CHICAGO 1, ILLINOIS • TELEPHONE STATE 0488
SUBSIDIARY COMPANY, FEDERAL BRILLIANT COMPANY, ST. LOUIS, MISSOURI

Branch Offices: Cincinnati • Dallas • Duluth • Houston • Indianapolis • Kansas City
Louisville • Milwaukee • Minneapolis • New Orleans • New York • Philadelphia

Vibration and Dust PROOF

McGILL Toggle Switches

Here is a new addition to the McGILL line of dependable switches . . . the McGILL Toggle Switch, Nos. 25, 27 and 28 Series. This small, practical, thin, multiple switch is both vibration and dust proof. With a body only 1" long, ½" wide and ½" thick, it fits into the shallowest of places. Approved by the Underwriters' Laboratories, it is ideal for the individual control of small tools, fractional horsepower motors, industrial and office machines, appliances, motion picture projectors, floor and table lamps, airplane and trailer lights, lights in Pullman cars, passenger cars and busses.

They are made in three types. No. 25 single pole rated 6 amp. "T" 125 volts, 3 amp. 250 volts. No. 27, three way, rated 6 amp. 125 volts. No. 28 two-circuit, no off position, rated 6 amp. 125 volts. All types furnished with wire leads or solder lugs.

McGILL Toggle Switches are easily installed and built for long life. See your dealer, or write for further information.

McGILL
MANUFACTURING
COMPANY, INC.
Electrical Division
VALPARAISO, INDIANA

***HIGH VOLTAGE LIGHTING** of the cold-cathode type provides a range of 5 to 15 foot-candles of general illumination in the train concourse of the remodeled Union Station at St. Louis, Missouri. Flexibility of control permits operation of double lines of tubing to provide the intensity range desired.*

consumption is 40,630 watts or 5.7 watts per lineal foot or approximately 28 lumens per watt.

Flexible circuit control provides for the operation of any two lines of tubing with a single transformer supplying 36 lineal feet of double-row tubing (72 feet total). Under usual daytime operation, only two lines of tubing in each row of reflectors are used to provide an average illumination intensity of five foot-candles. The potential intensity with all tubing illuminated is 15 foot-candles. Such measure of flexibility permits adequate lighting during low and peak traffic hours. Contributing generously to the overall illumination are many feet of sign tubing on the concourse.

Discussing the installation in *Illuminating Engineering*, R. D. Bradley, Day-Brite Lighting, Inc., and Frank B. Lee, General Electric Lamp Dept., St. Louis, reflect that it would require some 540 - 40-watt conventional fluorescent lamps to generate an equivalent amount of illumination as the present 1,188 cold cathode tubes. On a basis of continuous burning, the fluorescent installation would have required, at the most, twice as many trips up the maintenance ladder. In an installation of this type this would mean a three-man crew because of the ceaseless circulation of traffic presenting hazardous circumstances. Under the present system, the use of only two of the six lines of tubing permits immediate changeover in case a section goes out. In this way tube replacement may be postponed to some convenient time when the ladders and equipment of maintenance crews will least endanger the passing public.

GOOD LIGHTING PAYS DIVIDENDS

The General Products Company, Houston, Texas, manufacturers of welding pads, cable straps, stuffing and terminal tubes, were in a rather bad lighting predicament. Dark walls, coupled with comparatively high ceilings and rather spotty lighting combined to produce totally inadequate illumination for the tasks at hand.

Management then took a hand and experimented with individual machine lights. Still not satisfied with the results, they experimented with fluorescent units. They felt they had attained what they needed when W. N. Attaway, commercial and industrial lighting engineer for the Houston Lighting & Power Company proved, by means of his light meter, that, from the foot-candle standpoint, the plant was still pretty much in the dark.

Specialist Attaway's recommendations were followed and now a 200-watt (four, 40-watt fluorescent tubes in a ceiling suspended fixture) fluorescent unit mounted over the cutting tool portion of each machine provides from 40 to 50 foot-candles of evenly distributed illumination. Painting the walls a light color enhanced the lighting efficiency considerably. The new lighting brought amazing changes in the shop—no more dark corners for oil soaked rags, etc., less trouble hiring employees due to better working conditions and increased production.

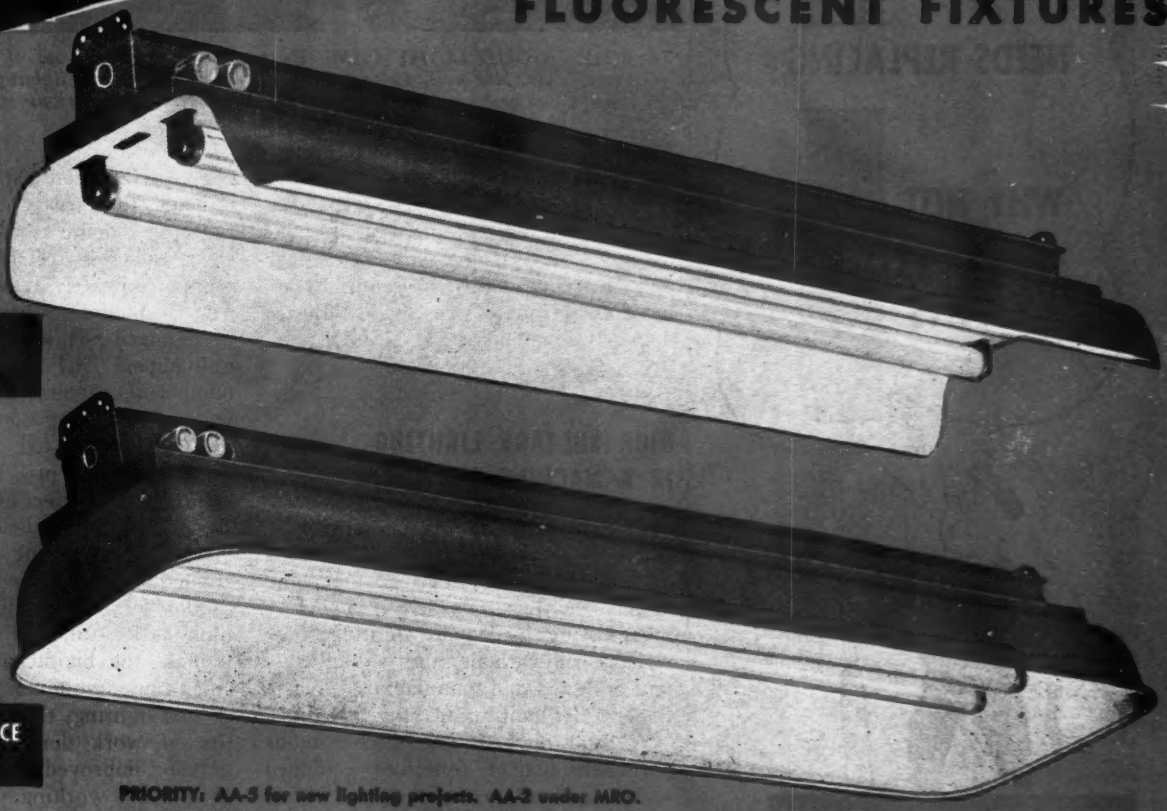
The following statements from management's acknowledgement of the improvement tells the whole story: "The seriousness of our lighting problem

Announcing

ALL-STEEL

NEW MITCHELITE

OPEN-END AND CLOSED-END FLUORESCENT FIXTURES



PRIORITY: AA-5 for new lighting projects. AA-2 under MRO.

- Rigid ALL-STEEL Construction.
- Open-End and Closed-End Types.
- Choice of Baked Enamel or Porcelain Enamel finish (all models).
- Simple, easy to install and service. Accessories provide for every method of mounting or hanging — Individually or in Continuous Rows.
- 2-40 watt, 3-40 watt and 2-100 watt models.
- "*Instant-Start*" available on 2-40 watt models.
- "Instant-Latch" releases reflector instantly.
- U. L. and E.T.L. Approved.

Here are the ALL-STEEL Fluorescent Fixtures you've been waiting for! 2-40 watt, 3-40 watt and 2-100 watt models with open-end or closed-end reflectors. Choice of Baked Enamel or Porcelain Enamel. "INSTANT-START" available on 2-40 watt models. All channels and reflectors are constructed of heavy gauge steel. Revolutionary new type "*INSTANT-LATCH*" for quick, easy release of reflector without use of tools. MITCHELITE Accessories provide for every method of hanging or mounting. Power factor over 90%. Stroboscopic corrected. Underwriters' Laboratories and E.T.L. Approved.

Get full details from your MITCHELL DISTRIBUTOR or write for Catalog No. 281.

MITCHELL FLUORESCENT

MITCHELL *Manufacturing Co.*

2525 N. CLYBOURN • CHICAGO 14, ILLINOIS

MAKE THE MAINTENANCE JOB

• • •

A Modernization Job!

IT'S EASY to modernize a wiring installation when you wire the P&S-DESPARD way. When a light switch needs replacing — add an extra outlet or pilot light — or both — in the same single gang box. Investigate the possibilities the P&S-DESPARD LINE has for you.

Sold Thru Electrical Wholesalers

Send for Complete Catalog

PASS & SEYMOUR, INC.
SYRACUSE 9, N. Y.

***WHEN GOOD LIGHT CAME IN** production lag went out of this Houston, Texas plant. Not until 40 to 50 foot-candles of fluorescent lighting boosted production and employee morale did management realize the seriousness of its inadequate lighting problems.*

was only realized after we had solved it. Most important of all is that we have had a definite increase in production . . . We have had an excellent and surprising return from our investment in lighting." Yes, good lighting does pay dividends.

HIGH VOLTAGE LIGHTING IN A MACHINE SHOP

The International Shoe Company, St. Louis, Mo., now has a modern lighting system in its machine shop. When the time came for remodeling the existing inadequate lighting, they chose a cold-cathode, high-voltage system designed and manufactured by the Federal Brilliant Company of St. Louis.

A total of 420 feet of continuous porcelain enamel reflectors equipped with two parallel rows of 20 mm., 3,500 degree white, cold-cathode tubing illuminates the area. The total lineal reflector footage is divided into three rows, each 140 feet long and mounted on approximately 12-foot centers at an 11-foot mounting height. The tubes, of standard 5-ft. length, operate on 60 milliampere, H.P.F. transformers, the number of transformers and secondary voltage depending upon the number of feet of tubing fed from each one. (Normally, a 60 ma., 15,000-volt transformer feeds 72 feet of 20mm. tubing.)

This newly installed lighting system blankets the working plane in the machine shop with an average of 20 foot-candles of evenly distributed general illumination and at the same time reduces the maintenance problems to an absolute minimum. With the advent of this lighting, the quality and quantity of work done in the shop has notably improved, as has the seeing ability and working morale.

***TRIPLE SHAFTS OF COLD CATHODE** lighting blanket the machine tools and work benches in this shoe plant machine shop with 20 foot-candles of evenly distributed illumination.*

Certified Ballasts & Starters

The *Heart* of Fluorescent Fixtures wearing this Label

FEW users realize the importance of Certified Ballasts and Certified Starters in the operation of fluorescent lighting fixtures. But they are so vital to good fluorescent lamp performance that it's doubly important to get fixtures with "control" equipment you can depend on. Like all parts of Certified Fleur-O-Lier fixtures they are tested and certified by impartial Electrical Testing Laboratories, Inc. of New York, as meeting definite Fleur-O-Lier standards.

Certified Ballasts and Starters can be readily identified by the E. T. L. shield. Look for it when you examine the fixtures you buy or specify.

Certified
FLEUR-O-LIER
The Manufacturer guarantees by affixing this label that this Fluorescent Luminaire is a duplicate of samples found by periodic examination to comply with the minimum requirements as set up in the
"SPECIFICATIONS FOR LUMINAIRES, FITTINGS AND AUXILIARIES FOR FLUORESCENT LAMPS"
Electrical Testing Laboratories, Inc.
NEW YORK, N. Y.
A COPY OF THIS CERTIFICATE SHOULD APPEAR UPON EACH UNIT OR PACKAGE
E.T.L.
E.T.L.

FLEUR-O-LIER MANUFACTURERS • 2121-8 KEITH BUILDING • CLEVELAND 15, OHIO

FLEUR-O-LIER

CERTIFIED FIXTURES FOR FLUORESCENT LIGHTING

Participation in the FLEUR-O-LIER MANUFACTURERS' program is open to any manufacturer who complies with FLEUR-O-LIER requirements

For Dependable Outdoor Lighting

NEW G-E WEATHERPROOF SOCKET

Use this sturdy weatherproof socket in industrial plants, steel mills, shipyards, railroad construction, mines, and outdoor jobs of all kinds. It will withstand rough handling during installation and will give lasting service in all weather. A weatherproof seal around the lead-in wires and screw shell prevents water from seeping into the socket from the top. Six-inch leads make re-use easy.

The weatherproof seal is made by pouring heat-resisting wax in a liquid state in the top of the socket. This wax covers the whole top of the screw shell and lead-in wire assembly; and it also fills the space between the screw shell and the body.

For further information, see the nearest G-E Merchandise Distributor or mail the coupon.

General Electric Company
Section D841-8
Appliance and Merchandise Dept.
Bridgeport, Conn.

Sirs: Please send me information on the new G-E weatherproof socket.

Name .....

Address ..... State .....

City .....

Buy War Bonds AND KEEP THEM

Hear the General Electric Radio programs: "The G-E All Girl Orchestra" Sunday 10 p.m. EWT, NBC. "The World Today" news every weekday 6:45 p.m. EWT, CBS.

GENERAL ELECTRIC

Where to Use Emergency Insulation

[FROM PAGE 44]

Type EI—Emergency Insulation (paper)

Type SN—Synthetic Insulation

Type SBW—Slow Burning Weatherproof Insulation

Type SB—Slow Burning Insulation

Type WP—Weather Proof Insulation

Type V—Varnished Cambric Insulation

Type RU—Rubber Insulation (Latex)

Type A—Asbestos Insulation

Type AVA—Asbestos Varnished Cambric Insulation (Asbestos Braid)

Type AVB—Asbestos Varnished Cambric Insulation (Flame-retardant Cotton Braid)

Type EG—Other type of insulation specially approved for the purpose (Interim Amendment No. 44)

Footnotes under Table 1 give the more definite limitations on the use of the various conductors in the different types of electrical construction.

Table 2 presents in concise form for easy reference and comparison the wartime current carrying capacities of the different insulated conductors. Values are taken from tables appearing in the interim amendments.

It is suggested that these tables be saved for ready reference. Although emergency insulations and substitutes will probably be discarded as war progress permits and more synthetic rubber enters the picture, we may still have to contend with these emergency regulations for some time to come. The above tabulations will prove helpful.

RED WING TRIO—From Red Wing, Minn., where first rural electrical project was started some 20 years ago, come contractors (L to R) E. A. DeWitt, C. A. Crandall and K. J. Koester to attend rural electrification clinic at recent N.C.E.I. War Conference in St. Paul.

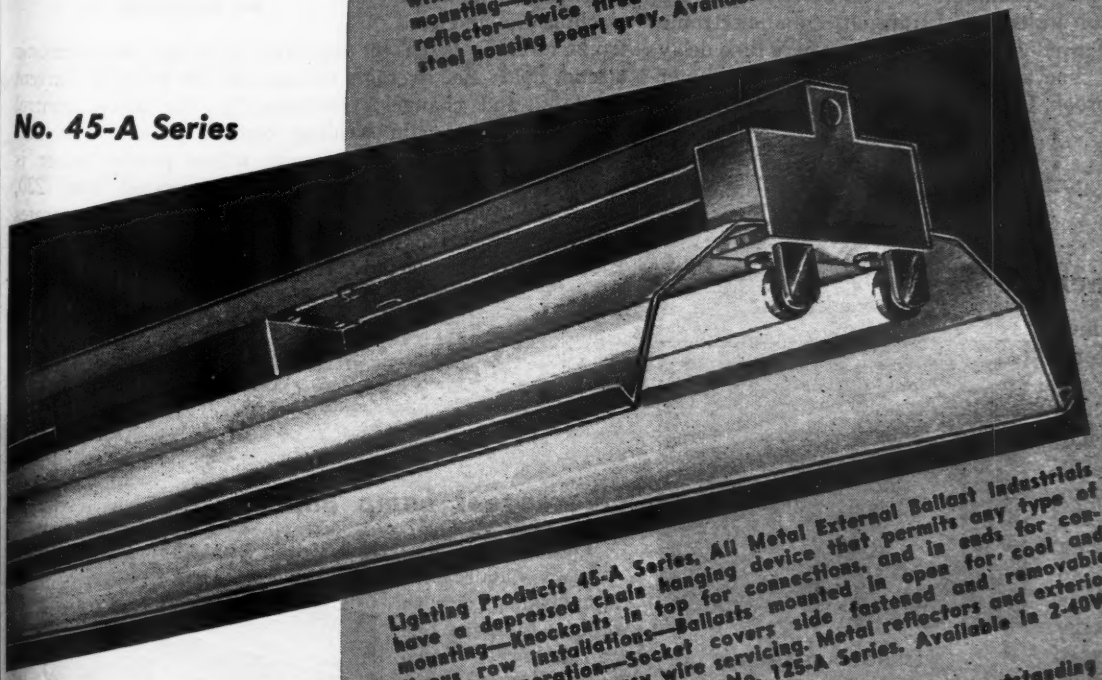
All Featured ALL METAL • FLUORESCENT INDUSTRIALS •

for either conventional or insta-start lighting . . . .

No. 125-A Series

Lighting Products 125-A Series, All Metal Enclosed Ballast Industrials incorporate all labor saving installation and maintenance features. Other features are drop ends for socket protection—starter changing without lamp removal—K.O.'s in ends for pull switches and continuous mounting—simple to install for any type of hanging. Finish inside of reflector—twice fired white enamel; exterior of reflector and all steel housing pearl grey. Available in 2-40W, 3-40W, and 2-100W units.

No. 45-A Series



Lighting Products 45-A Series, All Metal External Ballast Industrials have a depressed chain hanging device that permits any type of mounting—Knockouts in top for connections, and in ends for continuous row installations—Ballasts mounted in open for cool and efficient operation—Socket covers side fastened and removable channel covers for easy wire servicing. Metal reflectors and exterior of units finished the same as No. 125-A Series. Available in 2-40W, 3-40W, 4-40W and 2-100W units.

Send today for complete information on this new outstanding Metal Line.

LIGHTING PRODUCTS INCORPORATED
HIGHLAND PARK, ILLINOIS . . . . . U.S.A.

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising departments, tell them in what issue of ELECTRICAL CONTRACTING you saw the item and they will send full details to you.

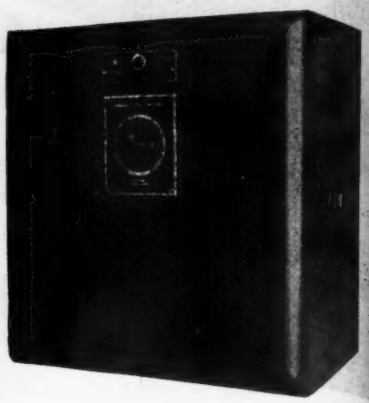
EQUIPMENT NEWS

Time Delay Relay

CRAMER RELAY

A new time delay relay for surface mounting that automatically resets on power failures has been announced. It is known as Type TD-4. It has a special overtravel mechanism which delays complete recycling in case of momentary power interruptions. It has a moisture-proof surface type mounting case. The relay is used for controlling the closing of plate circuits as in radio transmitters or rectifiers. They are especially suited for protection of transmitter and electronic tubes but have other industrial applications where time delay relays with fixed time are required. The R. W. Cramer Co., Inc., Centerbrook, Conn.

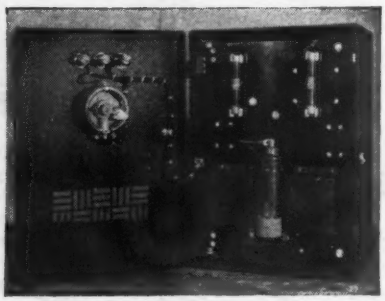
Voltage Regulator



G-E REGULATOR

This new electronic control eliminates poor resistance welds caused by voltage variations. It is designed to regulate the welding current automatically, so that it is held constant regardless of line-voltage variations. The regulator consists of a resistor circuit connected to the power line which supplies the welding machine and an electronic circuit. When the regulator is in use, the electronic circuit holds the average voltage of the resistor current constant, and changes, electronically, the phase control voltages of the main welding control panel. The unit can be used on welding circuits whose power factor is from 20 to 70 percent, and can be operated from 230, 460 or 575 volts on a 50-60 cycle power supply. It operates whether or not the welding current is flowing. General Electric Co., Schenectady, N. Y.

Welding Timer



WESTINGHOUSE TIMER

This new welding timer with heat control for timing intervals of one-half cycle or less is suitable for welding small objects of high conductivity. Because the welding current is made to start at the same point on the voltage wave for every operation, this timer is designed for welding of such items as radio tube parts and sockets, pig-tail resistors to terminal lugs, watch and instrument parts, contact tips on electrical relays and other small parts. The timer is furnished as a separate control for use with existing small bench welders and also in combination with a small welding transformer. Only one control tube is used, this thyratron serving the dual purpose of rectifying alternating current to charge a firing capacitor and also firing the small ignitron power tube. Heat control is accomplished by a phase shift method. Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

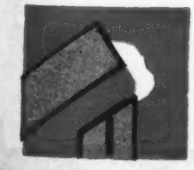
Fluorescent Lamp Ballast

JEFFERSON BALLAST

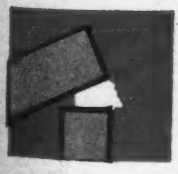
These newly developed fluorescent lamp ballasts are so designed that one ballast serves two purposes since the leads may be extended from the ends or bottom as the installation requires. Insulated bushings set at an angle protect the leads in either case. This makes unnecessary the production and stocking of separate ballasts, one type with end leads and another with leads extended from the bottom. It is available in the two-lamp 40-watt size. Jefferson Electric Co., Bellwood, Ill.

arcs leave this point Fast!

A POINT TO REMEMBER!



LIKE THIS. Diamond-pointed break jaws confine arcing to the point . . . force the arc to break outside the current carrying area. Contact surfaces stay clean . . . don't pit, don't burn.



NOT LIKE THIS. When ordinary safety switches are opened, the arc leaps across the contact areas . . . along the jaws and blade. It hangs on longer, burns and pits the contact surfaces.

When arcs hang fire, switch contacts become pitted and burnt . . . cause trouble. To avoid this, keep the arc away from the contact area—*and* put it out *quick!*

Westinghouse Safety Switches do *both*. The diamond-pointed jaw forces the arc to break outside the current-carrying area. Contacts stay clean, last longer, need less care, provide better protection.

For 575 or 600-volt circuits, Westinghouse provides extra protection—the exclusive "De-ion" arc quencher. Arcs are drawn into the grid chamber—divided—quenched quickly!

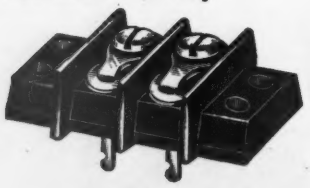
Protect circuits with Westinghouse Safety Switches. Ratings up to 1200 amps, 600 volts. Call your Westinghouse Representative today. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Dept. 7-N.

J-21299

Westinghouse SAFETY SWITCHES

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Terminal Strip



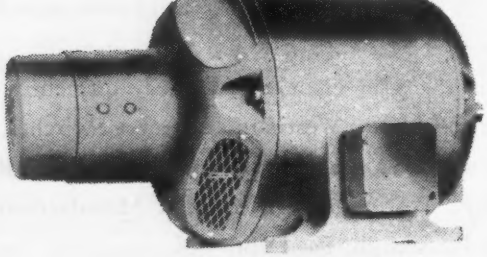
JONES TERMINAL STRIP

The "Y" type terminal permits connections both above and below the mounting surface. It can be mounted on the Jones standard Barrier strip and permits a screw connection above the panel and a solder connection below. The "Y" terminal mounts securely in the block and is also held by the screw so that the connecting wire comes in direct contact with the terminal. It is made for the Nos. 140, 141 and 142 Series Barrier strips. The barriers separating the terminals are of sufficient height to give the desired creepage distance and prevents shorts from frayed wires. Howard B. Jones Co., 2460 W. George St., Chicago 18, Ill.

Outdoor A.C. Welders

G-E WELDER

Two new outdoor alternating current welders, a 500-amp. type and a 300-amp. type have been announced. Both welders are designed for use in shipyards and similar outdoor locations where exposure to weather is common. The 500-amp. welder has a current range from 100 to 625 amp. and the range of the 300-amp. unit is from 60 to 375 amp. Welders are equipped with an "idlematic" control which reduces output voltage automatically to less than 30 volts whenever the arc is not in operation, yet provides full power for welding directly the arc is struck. Control is provided with a switch, operated by a handle projecting through the top of the case, for shutting off welder when not in use. All openings in top of enclosures of welders are of drip-proof construction. These welders incorporate built-in power-factor improvement, fingertip adjustment, stepless current control and fan-forced ventilation. General Electric Co., Schenectady, N. Y.

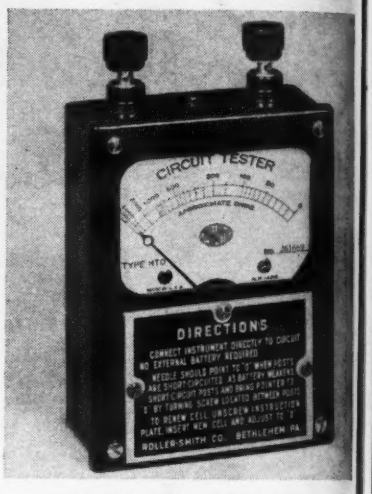


KATOLIGHT GENERATOR

Revolving Field Generators

These revolving field generators are built in sizes 5, 10, 15 and 25 kw. 4-pole, 1800 r.p.m., and in sizes 5, 10 and 15 kw., 6-pole, 1200 r.p.m. They can be furnished as independent two bearing generators suitable for belt or coupling drive or as single bearing generators designed to fit standard engine bell housing. They will carry 25 percent overload without exceeding allowable temperature rise. Voltage regulation is approximately 10 percent with 2-cycle speed change. Machines are furnished with damper winding which facilitates parallel operation of two or more generators. Generator is excited by a direct connected exciter at a standard excitation voltage of 125 volts. Unit is available in all standard voltages and frequencies. Kato Engineering Co., Mankato, Minn.

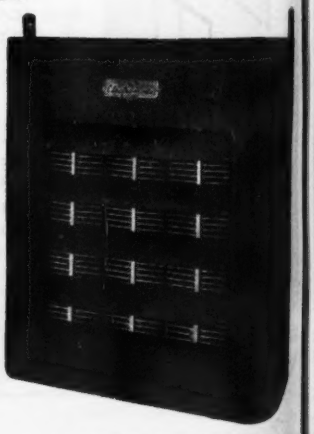
Circuit Tester



ROLLER-SMITH CIRCUIT TESTER

This pocket-type circuit tester is used to determine the resistance of an electrical circuit with the scale reading directly in ohms. It is furnished in a range from 0-10,000 ohms and can also be furnished with two ranges—0-5,000 and 0-50,000 ohms — HTD—3 Type. The instrument measures 4½ by 3 by 1½-in. with a weight of 19 ounces. It consists of a small d'Arsonval type d.c. voltmeter connected in series with a standard flashlight battery. Terminals are provided for connecting to the circuit under test. Removal of plate on front permits easy replacement of dry cell and also gives access to internal zero adjuster. Roller-Smith Co., Bethlehem, Pa.

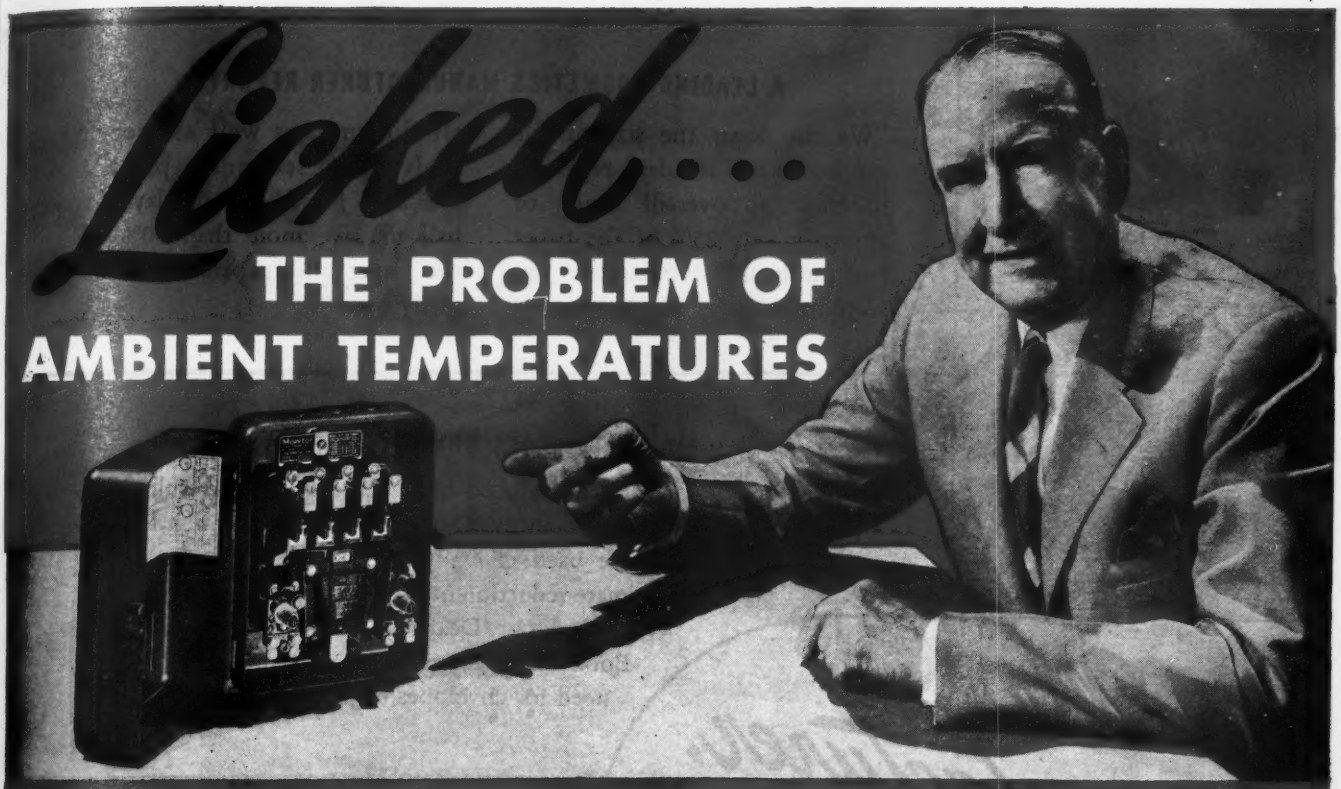
Electric Unit Heaters



ELECTRIC UNIT HEATER

This new line of standard electric unit heater models uses the one-piece finned aluminum elements. The elements consist of sheathed resistors cast in place of aluminum which has great thermal conductivity. No hot or incandescent wires are exposed, and oxidation and deterioration prevented. Six models, 1.5 kw. to 7.5 kw., can be used as portable heaters or arranged for ceiling or wall suspension, with the smaller sizes furnished with ON and OFF switch. Eight larger sizes, from 10 kw. to 60 kw., are for ceiling or wall suspension only. Automatic thermostatic control and contactors are available for use with any size heater. Electric Air Heater Co., Mishawaka, Ind.

Licked... THE PROBLEM OF AMBIENT TEMPERATURES



.... but it takes Monitor's Thermaload V Starter with Compensated Overload Relay to do the Trick

ONLY OVERLOAD CAN TRIP THIS COMPENSATED RELAY

Monitor's unique Compensated overload relay (right) consists of two bi-metal thermally-activated helices. When activated by ambient temperature, they oppose and nullify each other . . . thus no tripping action is imparted. HOWEVER—one helix is surrounded by a "heater coil" through which flows motor current. When motor current becomes excessive due to overload, the temperature rises in the heater coil . . . is then impressed upon the ONE helix . . . producing the motion necessary to open the tripping contact and disconnect the motor from the line.

YES, WE CAN SUPPLY YOU

with the Thermaload V from stock under existing priority regulations. Available for motor ratings up to 3 H.P., 110 Volts, A.C., and up to 7.5 H.P., 550 Volts A.C. Furnished also in combination units . . . choice of general purpose, dust-tight or water-tight enclosure. Mounting suitable for front or back-of-board wiring.

You'll find the answer to high, low and variable temperature problems (often the cause of unjustified shutdowns or motor damage due to overload) in Monitor's Thermaload V solenoid starter. This proved starter differs from *ordinary* starters because of its compensated overload relay—an exclusive Monitor feature. This unique relay makes possible 100% starter performance regardless of installation characteristics. That's a mighty important "plus" for you—and here are five additional Monitor features you can't afford to overlook: (1) Interchangeable coils for different voltages, (2) Double-break silver-to-silver contacts, (3) Tamper-proof reset button, (4) Accessibility of parts for easy maintenance, (5) Built-in quality.

Get the full story on the ingenious Thermaload V—with compensated overload relay—at your earliest convenience. See the Monitor field engineer in your locality—or write direct for descriptive Catalog 6300.

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Trumbull Enclosed Industrial Multi-Breakers provide automatic overload and short circuit protection for vital light and power services, (Alternating Current up to 100 Amp. maximum) at a price comparable with fusible equipment.

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These Heavy Duty Multi-Breakers prevent unnecessary production delays, because after short circuit has been removed, there is nothing to replace or renew. Service can be restored immediately by simply throwing handle to "off" and then to "on" position.

Equipped with thermal trip, providing accurately calibrated time-delay on small overloads, supplemented by magnetic trip, providing instantaneous operation on short circuits and high overloads. They eliminate maintenance problems and are real time and trouble savers.

Write for Trumbullaid Circular 333 giving full details and specifications.

Availability

Available in two sizes for 230 V. AC only. 2 and 3 pole.

Common Trip

Type M-1, 50 Amp. frame size, rated 15 to 50 Amps.

Type M-2, 100 Amp. frame size, rated 50 to 100 Amps.

Quick-Make and Quick-Break; Trip Free Operation. Current interrupting capacity 5000 Amps., R.M.S. at 230 V. AC.

ENCLOSURES are dust-resisting . . . equipped with external front operated self-indicating handle, which can be padlocked in "on" or "off" position. Furnished for surface mounting only. Finish: Baked machine gray enamel.

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PRACTICAL ARTICLES on the application, installation and maintenance of electronic apparatus in industry. Readers are invited to contribute items from their experience to this department. Articles used will be paid for.

ELECTRONICS

Installing, Maintaining and Servicing Electronic Relays and Timing Relays—II

A detailed account of trouble-shooting electronic timing relays. Use of the cathode ray oscilloscope shown an invaluable aid.

By E. D. Schneider

Industrial Control Engineering Division
Electronics Section
General Electric Company

IN the first part of this article dealing specifically with electronic relays and electronic timing relays the procedure has been outlined for their installation and scheduled maintenance. In addition a troubleshooting chart has been included for the electronic relay. In this, the second part, we shall deal exclusively with the servicing and trouble-shooting of the slightly more complicated device, the electronic timing relay.

Trouble-Shooting

The procedure for servicing electronic timing relays is also similar to that for servicing electronic relays. If this servicing does not locate the defect, follow the suggestions outlined in Part I of the "Trouble-Shooting Chart."

Sometimes, it is difficult to determine whether or not the electronic timing relay itself is operating. This can be checked by disconnecting the wires to the initiating contacts and using a separate initiating switch connected directly to the terminals on the timer. Operate this switch in the usual manner and observe the operation of the time relay and compare the time delay with the calibrated values.

It may be of help to observe changes of magnetic relay coil voltages during a timing cycle. This can be done most readily by connecting to the coil of the magnetic relay a high-resistance d.c. voltmeter or multimeter, such as described in a previous article. In some forms of electronic timing relays when the potentiometer is set for maximum time delay, the relay voltage will be zero for about 80 percent of the time after the initiating switch is closed. The voltage then gradually rises and at a certain value the magnetic relay should pick up. In another type of timing relay, the coil voltage is maximum and the relay energized before the initiating switch is closed. As soon as the initiating switch is closed the voltage becomes zero and remains zero for about 80 percent of the time and then gradually rises.

In general, the voltage rises near the end of the time delay period in an electronic timing relay using *vacuum tubes.* If the timing relay uses a *thyratron tube,* the voltage will change

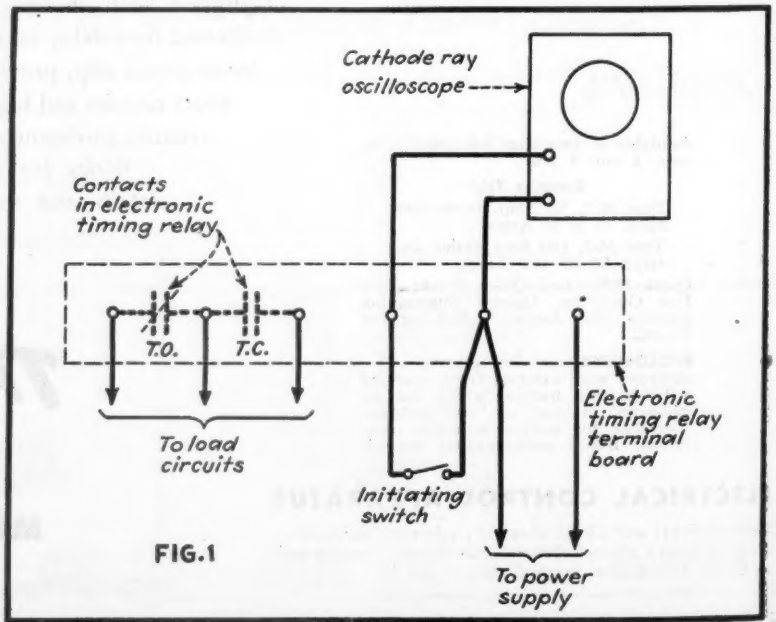


FIG. 1 Use of cathode ray oscilloscope to check presence of transient or undesirable voltages in wires from an electronic timing relay to initiating switch.

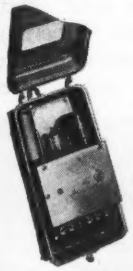
How would you use these 3 industrial electronic servants?

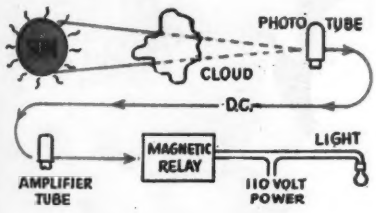
UNITED CINEPHONE CORPORATION, of Torrington, Conn., has developed three simple electronic devices that almost every industrial plant can — and some day *will* — use to advantage

The Sun-Switch turns factory or office lights off or on *automatically* when outdoor light rises or falls, avoiding poor work caused by bad visibility or eye fatigue.

It can also be used to switch on or off aircraft beacons, and outdoor lighting of all kinds.

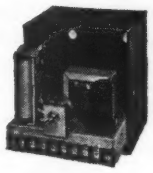
What Is It? The "Sun-Switch" is a phototube device, in which a change of light is used to operate a magnetic switch. The tubes are: an RCA type 930 phototube followed by an RCA 6SJ7 detector-amplifier and an RCA 6SN7-GT amplifier.

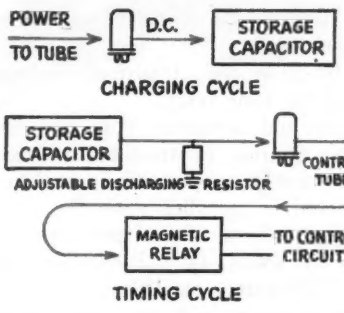




How It Works: When sufficient light strikes the phototube, its output, amplified by the following tubes, operates a magnetic relay which turns *off* the lights. When the light striking the phototube decreases to a preset level, the lights are switched on again. The light-level range is adjustable.

Electronic Timer: The United Cinephone electronic timer accurately time-controls operations of machine tools, molding presses, ovens, electronic heaters, photographic printing, etc. Two or more timers can be connected to provide automatic sequences. Time interval is adjustable from 0.05 to 100 seconds. Avoids human error. Easy to set; wide range; no resetting needed; hundreds of thousands of operations with virtually no maintenance.

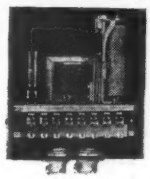


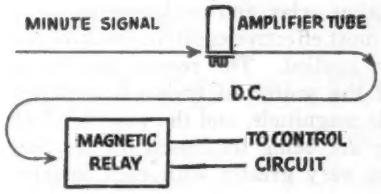


How It Works: An RCA 6J5 amplifier tube is used. It first acts as a rectifier, supplying d-c to a storage capacitor. When the time interval is "initiated" by the initiating switch, the stored energy is dissipated through an adjustable resistor. When the voltage across the storage capacitor thus drops to a preselected value, the tube supplies current to operate a sensitive magnetic relay.

Electronic Switch: For reliable switching where a tiny current can replace heavy currents or mechanical devices. Only 3/1,000,000 ampere will actuate the electron tube which operates the relay.

The small current replaces heavy currents required in some chemical processes or machine or gauging operations where a relay is actuated directly. Excellent for floatless control of liquid levels, pressureless limit-switching, and to replace clumsy, slow, leverage systems. Operates up to 800 times per minute; has exceptionally long life and low maintenance. Widely used in industry.





How It Works: A tiny current flowing through the external circuit and through a very high resistance (1 million ohms or more) develops enough voltage across the resistance to control the current flow through an RCA 6J5 detector-amplifier tube. The tube current operates a magnetic relay.

The magic brain that powers these devices is in each case an RCA Electron Tube

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Industrial electronics, already widely accepted, is destined to play a giant's role tomorrow. If you suspect that measuring, counting, weighing, sorting, controlling, heating, or some other mechanical or manual operation in your plant can be more accurately, efficiently, or profitably performed "the electronic way," you are probably right. Why not write to us, stating your problem, so we can refer you to the equipment manufacturer best fitted to serve you?

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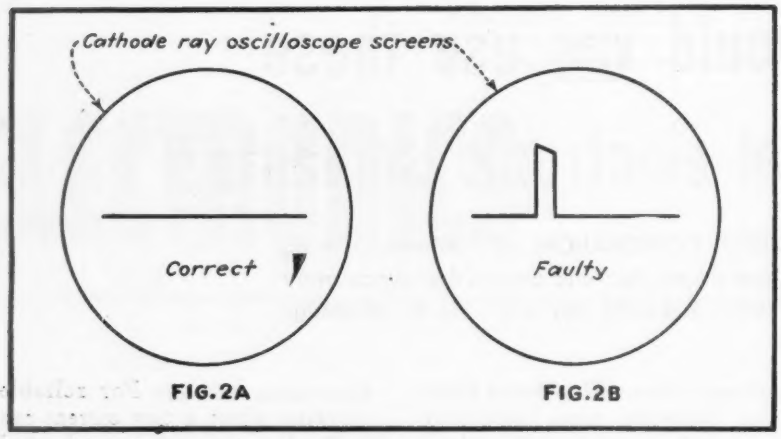


FIG. 2A Trace indicates initiating switch remains closed and no transient voltages present in circuit to initiating switch. Fig. 2B Trace indicates either the initiating switch has bounced open momentarily or transient voltages are present in circuit to initiating switch.

abruptly at the end of the time-delay period.

Troubles due to factors outside the timing relay

Troubles due to factors outside the electronic timing relay are usually of two kinds: recycling and inconsistent timing. Where such troubles occur, it is usually possible to trace their cause to transient voltages which affect the operation of the time relay.

Where trouble of this kind is encountered, it is difficult and sometimes impossible to watch the operation of the time relay and to determine when the most effective curative measure has been applied. The reason for this is that the source of transient voltages, their magnitude, and the way in which they are being impressed on the time relay vary greatly with each installation.

The use of a cathode ray oscilloscope may be helpful in determining how such transients are getting into the electronic timing relay circuit. Connect the oscilloscope to the terminals on the relay to which the initiating switch or contacts connect. See Fig. 1. When the initiating contacts close, the trace seen on the oscilloscope screen should immediately take a position corresponding to zero voltage and remain at zero for as long as the initiating switch is closed. Such a trace is shown in Fig. 2A. If the trace does not remain at zero as in Fig. 2B, it indicates that transient or other undesirable voltages are being introduced into the electronic timing relay circuit and steps must be taken to eliminate this voltage or to reduce it to a minimum. Several suggested corrective measures are given below.

The remedies suggested in the trouble-shooting chart are those that have been found to work in majority of cases. Frequently, it may be necessary to try others. One method of attack is to study the wiring arrangement of the devices connected to the time relay, and to try to decide which ones are the sources of the transient voltages.

There are then two ways to prevent these transient voltages from affecting the time relay:

1. Suppress the transient voltage at the source; or
2. By-pass the transient voltage around the time relay.

Relay and contactor coils are frequently sources of transient voltages which can be suppressed by resistors connected in parallel with the coils. (Typical values of resistors are 400 ohms (35 watts) on 115 volts, or 1000 ohms (50 watts) on 230 volts.)

The transient voltages may appear across closed contacts when they open, or across open contacts which bounce on closing. A small capacitor (about 0.05 microfarad) connected across these contacts, as in Fig. 3, is frequently a sufficient remedy.

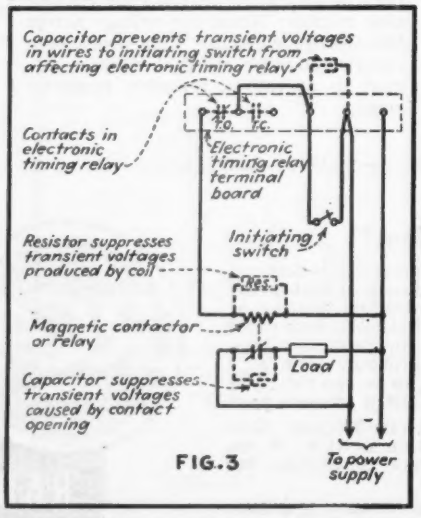

Capacitor prevents transient voltages in wires to initiating switch from affecting electronic timing relay
Contacts in electronic timing relay
To
Tc
Electronic timing relay terminal board
Resistor suppresses transient voltages produced by coil
Initiating switch
Magnetic contactor or relay
Load
Capacitor suppresses transient voltages caused by contact opening
To power supply
FIG. 3

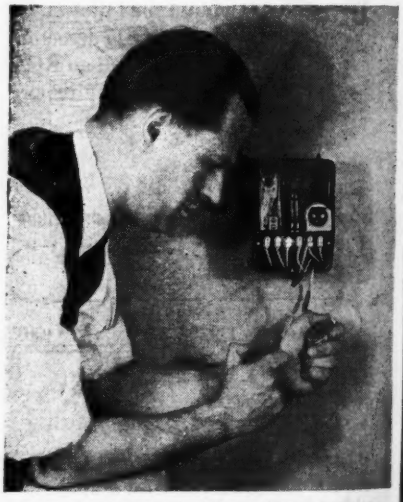
FIG. 3. Some typical methods of correcting trouble due to transient voltages. (see "Trouble-shooting Chart — Electronic Timing Relays Parts II and III")

If the number of these devices is large, it may be uneconomical to add these corrective measures to each. Consideration should then be given to by-passing the transient at the terminals on the time relay. This may be done, sometimes, by connecting a capacitor (about 0.05 microfarad) to the initiating terminals on the time relay, as shown in Fig. 3.

Recycling

Part II of the trouble-shooting chart suggests remedies for trouble under—"Timing relay recycles—magnetic relay alternately picks up and drops out." This recycling usually occurs after the timing relay has timed out and the initiating contact is still in the timing position.

When servicing trouble of this kind it is desirable to have some method of determining when the most effective remedy has been applied. One way is to connect a d.c. voltmeter to the coil of the magnetic relay and to observe



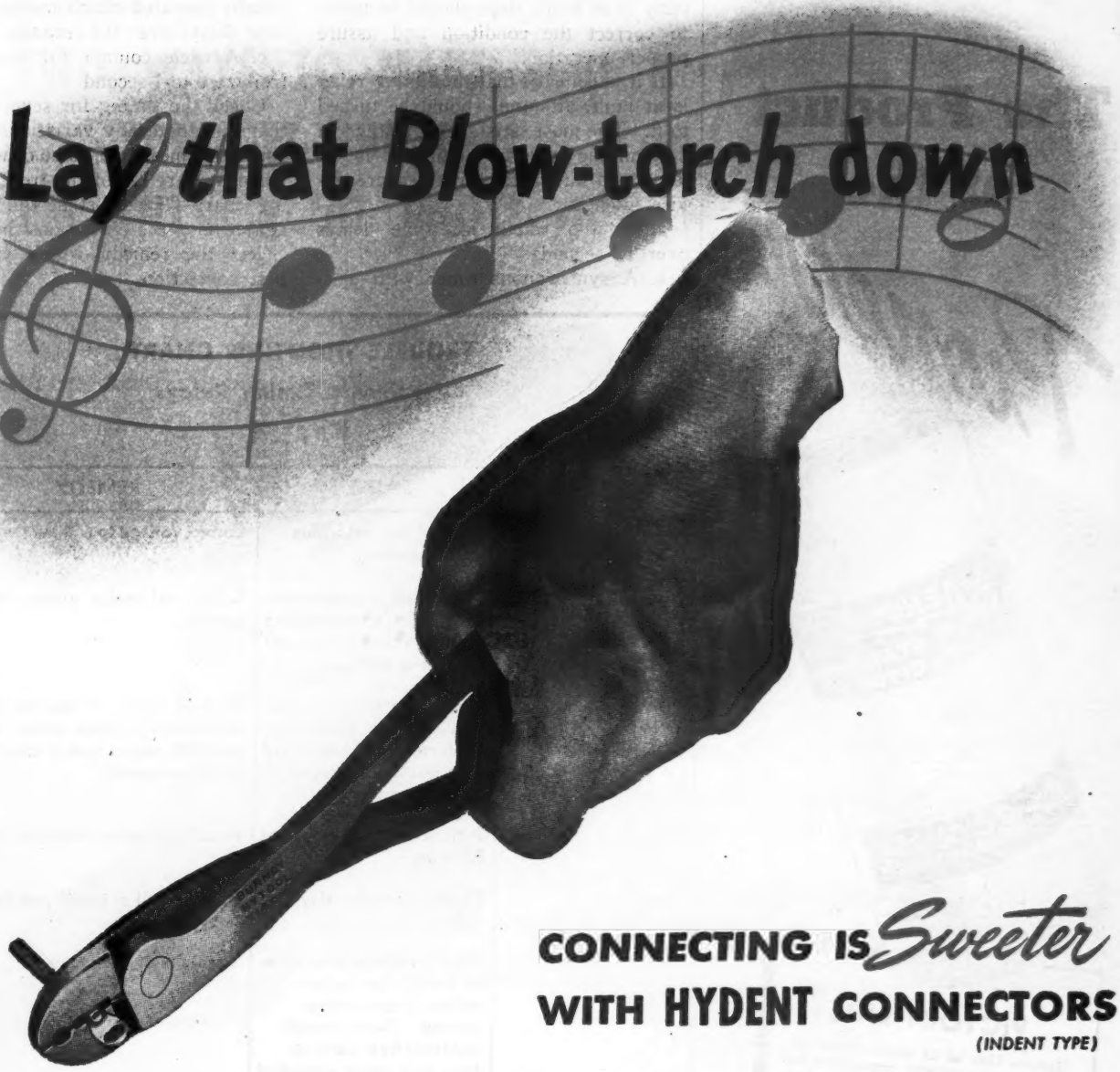
ELECTRONIC TIMING RELAY being operated with a separate initiating switch and time delay being checked by a stop-watch.

the changes in voltage whenever recycling occurs. When the timing relay recycles or tends to recycle, the voltage will dip, sometimes a little and sometimes to zero. When complete correction has been applied the voltage should not dip.

Inconsistent Timing

There may be devices in the installation, other than the electronic timing relays, that are not consistent in operation and which may be the cause of the inconsistent timing. It is suggested that a study be made of the entire installation to determine what is responsible for the poor results. If the analysis of the equipment shows that a device other than the timing

Lay that Blow-torch down



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Handy Aerovox conversion chart indicates Victory equivalent for any previously available type.

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relay is at fault, steps should be taken to correct the condition and assure proper operation.

If it is believed that the timing relay is at fault, attention should be turned to it. The most satisfactory method of determining errors in timing is by use of an automatic time measure device, such as:

a. A stop watch for time delays over 15 seconds

b. A synchronous timer with electrically operated clutch mechanism for time delays over 0.5 seconds

c. A cycle counter for time delays from zero to 1 second

Check the timing for several operations and note any variations. Apply corrective measures, some of which are listed in Part III of the trouble-shooting chart—"Inconsistent timing," and again note the variations in timing. Select the remedy which yields the best correction.

TROUBLE-SHOOTING CHART

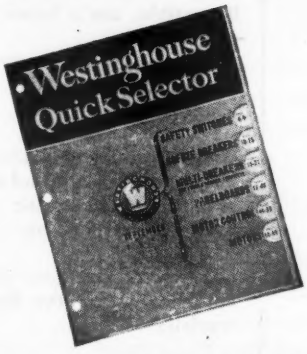
Electronic Timing Relays

Part I

TROUBLE	CAUSE	REMEDY
Magnetic relay does not operate at end of time delay after initiating contact has been operated.	Line voltage not within limits specified.	Correct voltage to within rated limits.
	Proper tap on electronic timing relay corresponding to line voltage may not have been used.	Select and make proper tap connection.
	Positioning key in center of tube base (radio-type tubes) may be broken and tube has been placed in socket incorrectly.	Replace tube. If another tube is not available, check mating of tube pins with proper socket holes before replacing socket.
	Initiating contact does not function.	Repair or replace initiating contact.
	Open magnetic relay coil.	Replace coil or install complete new relay.
	Wires touching each other or panel wires loose—soldered connections broken. Parts normally insulated from panel or from each other grounded or touching.	Locate fault and repair.
	Defective circuit components, such as resistors, capacitors, etc.	If circuit voltages have been included with instructions, check these voltages with a multimeter as a means of locating trouble. Otherwise, make a visual inspection of the device for defective parts. Check resistance of resistors and coils with an electronic voltmeter-ohmmeter. The resistance of resistors should be within 10% of the rated value. Check capacitors, other than electrolytic types, with ohmmeter. Defective capacitors will show practically zero resistance. Check electrolytic capacitors with capacitance meter. Particular attention should be given to electrolytic capacitors, since this type of capacitor has a limited life and failure may occur after several years of operation. When replacing, be sure to observe polarity.
Magnetic relay on the electronic timing relay opens and closes at rapid rate.	Capacitor which is connected in parallel with relay coil may be open.	Replace capacitor.

[Continued on Page 126]

TWO WAYS TO MAKE SURE YOU GET THE BEST IN PLANT CIRCUIT PROTECTION



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Write or wire for new, complete catalog.

TALK-A-PHONE MFG. COMPANY
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Talk-A-Phone

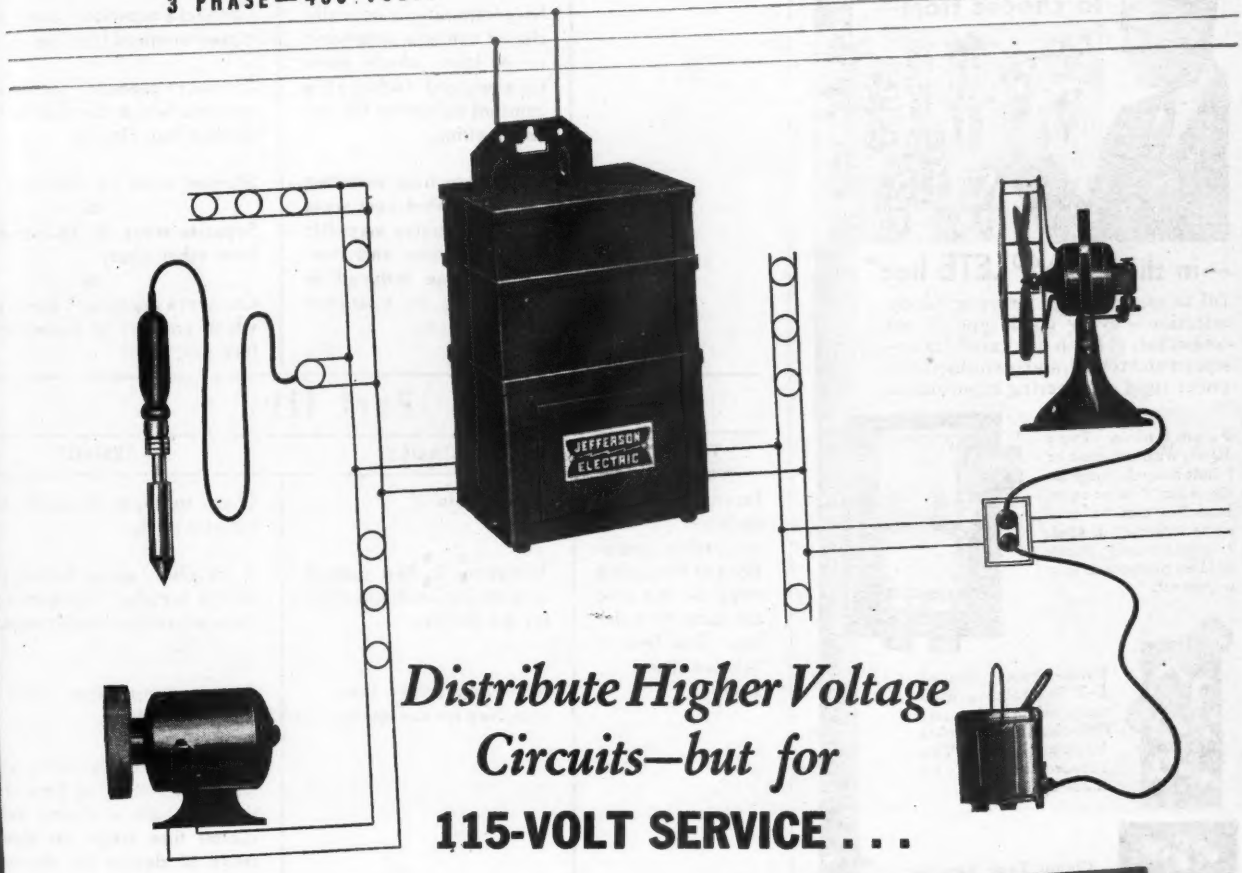
TROUBLE	CAUSE	REMEDY
Contacts on telephone type magnetic relay either stick or do not make good contact.	Insufficient wipe of normally closed contacts.	Adjust armature stop to obtain about 1/16" clearance between armature and contact spring.
	Contacts worn badly.	Replace relay.
Time delay not smoothly adjustable by the potentiometer or rheostat.	Potentiometer or rheostat has failed.	Replace defective part.
Time delay always minimum.	Potentiometer open on "maximum" end.	Replace potentiometer.
	Defective tube.	Replace tube.
	Timing capacitor shorted or open-circuited.	Replace capacitor.
	Defective resistors, capacitors, etc.	Locate defective part and replace. Resistors and capacitors (except electrolytic types) may be checked with electronic voltmeter-ohmmeter. Resistance of resistors should be within 10% of their rated value. Defective capacitors will show practically zero resistance. Check electrolytic capacitors with capacitance meter.
Time delay always maximum.	Potentiometer open on "minimum" end.	Replace potentiometer.
	Defective resistors, capacitors, etc.	Locate defective part as above and replace.

Part II

Trouble due to factors outside the electronic timing relay. Most troubles outside the timing relay are due to transient voltages which affect the operation of the timing relay. See text.

TROUBLE	CAUSE	REMEDY
Timing relay recycles—magnetic relay alternately picks up and drops out. See text under "Recycling."	Excessive line voltage regulation.	If possible, use a better regulated power supply; or Install a constant-voltage transformer; or Use an auxiliary magnetic relay that picks up and seals in and closes load circuit when magnetic relay on timing device picks up; or Use form of electronic timing relay not affected by the line voltage regulation.
	Initiating contact bounces open due to vibration of devices on which initiating contact is mounted.	Arrange initiating contact so it will not bounce open; or Use an auxiliary magnetic relay with coil controlled by initiating contacts and with contacts on relay used to initiating timing relay.
	Magnetic relay's normally open contacts connected to a load which when energized induces a transient voltage in the external wiring.	Connect a resistor across the load with shortest possible wires: (Typical values: 400 ohms on 115 volts, 1000 ohms on 230 volts.) or

[Continued on page 128]



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Modern practice eliminates duplicate power and lighting circuits. Only the high voltage is distributed and Jefferson Electric Power Circuit Transformers installed to provide the lower voltage (115 V) for lamps, fans, control push buttons, and electric heating and small motor-driven appliances where desired.

WIRING IS SIMPLIFIED

Jefferson Electric Transformers being air-cooled may be mounted at locations where the 115-volt current is required—on walls, posts, or directly on machines. No vaults or enclosures are required.

Made by transformer specialists, generously proportioned and capable of long-hour service, Jefferson Power Circuit Transformers embody the features of engineering design and construction that a quarter of a century of transformer manufacture makes possible . . . They have been selected and installed in the plants of many of America's foremost manufacturers,—Douglas Aircraft, Buick, Pratt & Whitney, Allison, Chrysler, Curtiss-Wright, Frigidaire,—to mention but a few. Write for data Bulletin 421-PCT. JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago) Illinois. In Canada: Canadian Jefferson Electric Co., Ltd., 384 Pape Avenue, Toronto, Ont.

JEFFERSON ELECTRIC

In addition to 115-volt secondary transformers, types with 32-volt secondary are available for 32-volt lamps mounted directly on machines. These lamps withstand vibration and reduce lamp pilferage.

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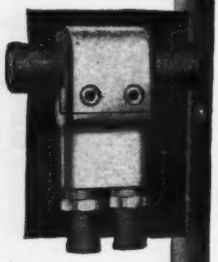
All in one catalog, for your handy selection—*every* good type of tee connector... Each one carefully designed and tested, and manufactured under rigid engineering supervision.

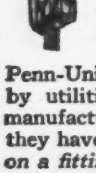


Penn-Union Type HFM, with one-bolt or 2-bolt hinged clamp for the main. One or more branches can be connected afterward. Multi-slit tapered sleeve assures permanent grip on branch.

Penn-Union Hinged E-Z Tee takes a wide range of branch sizes. One-piece design makes installation easy. Tap connections can be made at any time.

Clamp Type Tees for all sizes of tubing and cable—a complete line. Machined contact surfaces.

Types for All Combinations—for connecting flat bar, run or tap, to tubing or cable. Also "general utility" tees that take a wide range of conductor sizes.



Penn-Union E-Z Tee is ideal for accommodating a large range of conductor sizes on both the main and branch. Will not loosen. 2, 3 or 4-post.

Penn-Union fittings are preferred by utilities, industrials, electrical manufacturers, contractors—because they have found that *Penn-Union on a fitting is their best guarantee of Dependability.*

PENN-UNION ELECTRIC CORPORATION
ERIE, PA. *Sold by Leading Jobbers*

PENN-UNION
Conductor Fittings

TROUBLE	CAUSE	REMEDY
		Connect a capacitor* across terminals on timer which connect to initiating contact.
	Magnetic relay's normally closed contacts connected to a load which when de-energized induces a transient voltage in the external wiring.	Connect a capacitor* across normally closed contacts (see Fig. 3) or Connect a capacitor* across terminals on timer which connect to initiating contact (see Fig. 3).
	Long wires from initiating contact located near wires used to energize magnetic control devices and transient voltage induced in these wires by operation of the devices.	Shorten wires to initiating contact; or Separate wires to initiating contact from other wires; or Connect a capacitor* across terminals which connect to initiating contact (see Fig. 3).

Part III

TROUBLE	CAUSE	REMEDY
Inconsistent timing—successive operations of the timing relay do not give the same time delay. See text, "Inconsistent Timing."	Defective tube.	Check tubes, or if unable to do so, try new ones.
	Variations in line voltage outside the limits specified for the device.	If possible, use a better regulated power supply. Otherwise install a constant-voltage transformer.
	Reset-time shorter than specified for the device.	Rearrange operating cycle to give longer reset time; or If timing relay is being used near minimum setting of time delay adjustment, use a timing relay with shorter time range, or shorten time range of device by decreasing resistance of the timing resistor.
	Variations in temperature. The time delay of electronic timing relays whose timing capacitors are filled with Pyranol or similar material will decrease 30 to 40 per cent when the temperature decreases below about 32° F.	Locate timing relays, whose timing capacitors are filled with Pyranol or similar material, so they will not be subjected to temperatures below 32° F.; or If temperatures below 32° F. are to be encountered, use oil-filled or other suitable timing capacitors.
	Bouncing initiating contact. Most contacts bounce on closing. When the contact both energizes a load and initiates the timing relay, the transient voltage appearing across the contacts is introduced in the timing circuit.	Use separate isolated contact for initiating the timer; or Connect a resistor in parallel with the load to suppress the transient voltage (typical values: 400 ohms for 115 volts; 1000 ohms for 230 volts) (see Fig. 3); or Connect a capacitor* across terminals which connect to initiating contact (See Fig. 3).
	Bouncing contacts in the general control wiring. One contact initiates the timer and a separate contact energizes the load. The contact which energizes the load bounces and causes a transient voltage to be induced in the supply lines connected to the timing relay.	Use a separate power supply for the timing relay; or Connect a resistor in parallel with the load to suppress the transient voltage (typical values: 400 ohms for 115 volts; 1000 ohms for 230 volts).

* Typical values: 0.05 or 0.1 microfarad

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"In the gloaming when the lights are low"

WHAT'S our old friend, Bill Bjones, up to now? Well, for one thing, he's *not enjoying* one of the greatest boons of modern living—*good lighting.*

Poor fellow! His home is *inadequately wired* to carry the electrical loads imposed by modern lighting and electric appliances.

So, with *other* loads on his circuit, he just isn't getting enough current. Adding lamps isn't the answer . . . *better wiring is.*

Anyway, the Bjones' home is no exception to the rule that approximately 95% of the homes in America are inadequately wired for present electrical loads—not to mention the greatly increased loads that will come in postwar years.

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"Electrical Living in 194X" answers practically every question your prospects may ask regarding increased electrical loads in future homes—lighting and lighting controls—modern circuit protection—entrance equipment and distribution panels.

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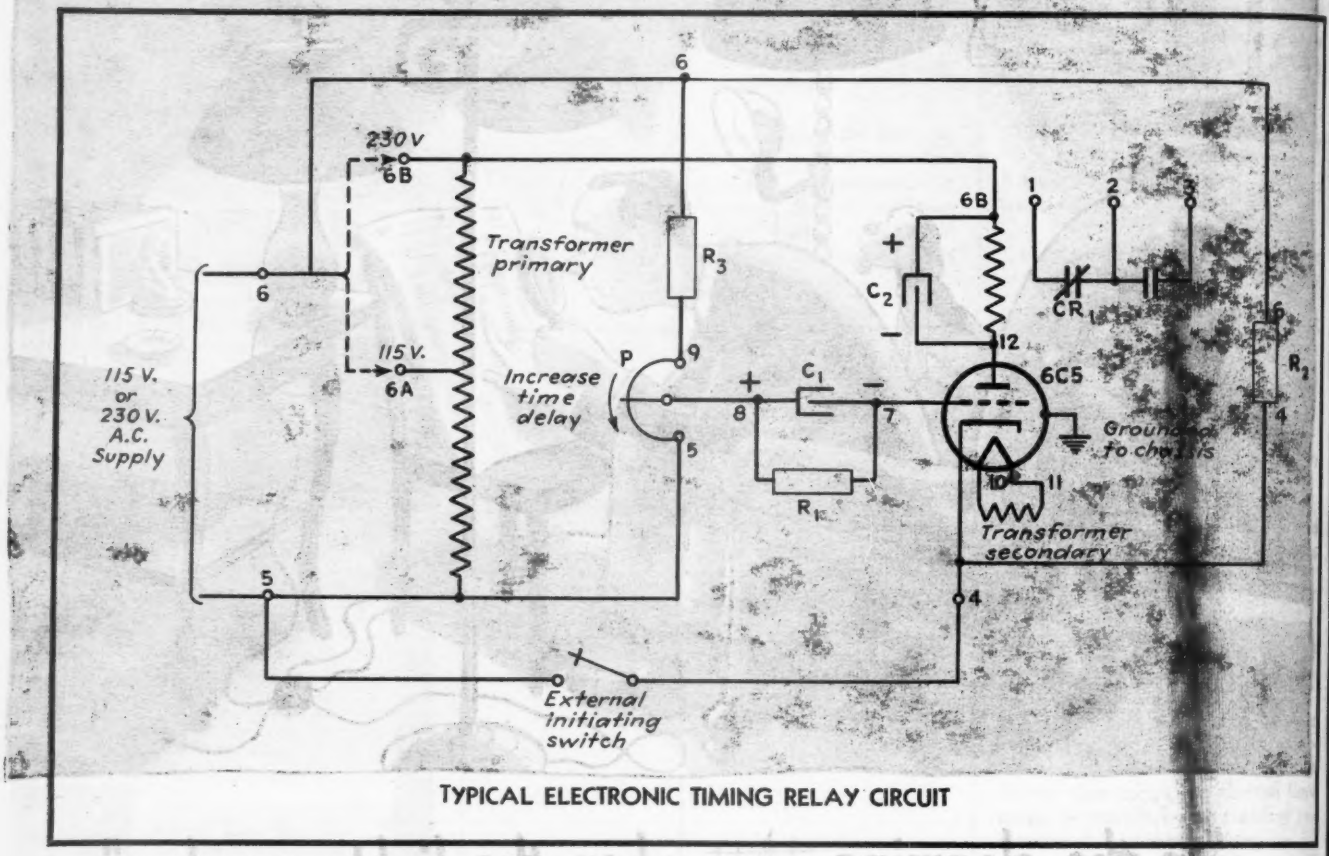
Shooting Trouble on Electronic Timing Relay After it Has Been Removed From Service



TYPICAL ELECTRONIC TIMING RELAY CIRCUIT

In order to illustrate location of defective circuit components or wiring assume a timing relay using the circuit above has failed in service. Also assume that new tubes and a careful inspection of the installation did not correct the trouble and the device has been removed to the service department.

Above is a typical electronic timing relay circuit in which the circuit components should be as follows for a timing range of 3 to 60 seconds:

C1 = 2 mfd. capacitor
C2 = 6 mfd. capacitor (electrolytic type)
CR1 = Relay whose coil resistance = 6500 ohms
P = 10,000 ohm potentiometer
R1 = 10 megohm resistor
R2 = 10,000 ohm resistor
R3 = 12,500 ohm resistor
Transformer primary rated 115/230 volts.
Transformer secondary rated 6 volts.

The operation of this circuit has been described in a previous article.

Shooting trouble on an electronic device should proceed in a systematic manner as follows:

1. Check the operation of the device in the service department.

2. Measure the transformer secondary voltage with an a-c voltmeter (should be about 6 volts.)

3. Remove the timing relay from its case and carefully examine visually all parts. This visual examination is very important because frequently a failure of insulation, circuit component, or wiring will have left some telltale trace which indicates the location of the fault.

4. Check resistances with suitable ohmmeter as follows:

4a. Remove connection from 6 to 6B (or 6A).

4b. R3 — Measure resistance of R3 (should be 12,500 ohms).

4c. (1) P — Measure resistance of P (5 to 9) (should be 10,000 ohms).

4c. (2) Connect ohmmeter from 8 to 9 and gradually turn shaft of P from 9 to 5. Resistance should gradually increase from zero to 10,000 ohms.

4c. (3) Connect ohmmeter from 5 to 8 and gradually turn shaft of P from 5 to 9. Resistance should gradually increase from zero to 10,000 ohms.

4d. R2 — Measure resistance of R2 (should be 10,000 ohms).

4e. CR1 — Connect ohmmeter from 6B to 12 to measure resistance of CR1 coil (should be 6500 ohms). Note: If C2 is electrolytic type, disconnect one wire from capacitor before measuring coil resistance.

4f. R1 — Connect ohmmeter from 7 to 8 to measure resistance of R1 (should be 10 megohms). Note: Ohmmeter should be set on 50 megohm scale at least. If resistance is low, C1 may be shorted. Disconnect one wire from resistor R1 and measure resistance of R1 again.

4g. Connect ohmmeter (or preferably a 500 volt "Megger") from various terminals to chassis or panel to determine if any components or wiring have failed by grounding. If certain parts of the circuit are intentionally grounded, these wires should be disconnected from chasis or panel while making this test. If a ground is still present, parts should be disconnected one by one until the faulty component or wiring is located.

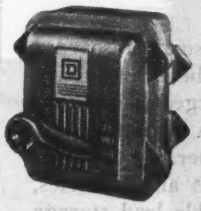
5. Check capacitors for shorts with a suitable ohmmeter or measure their capacitance with a capacitance meter. Note: Capacitors which fail usually do so by becoming shorted, however, electrolytic capacitors may fail by becoming open-circuited.

5a. C1 — Disconnect one wire to resistor R1. Connect ohmmeter to C1. Resistance should be 100 megohms or higher.

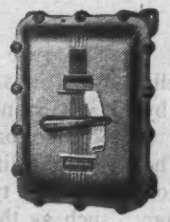
5b. C2 — Disconnect one wire from capacitor C2. Connect ohmmeter to C2. Resistance should be 100 megohms or higher. If C2 is electrolytic type, measure capacitance with capacitance meter. Note: If relay CR1 chatters and fails to pick up during operation in No. 1 above, capacitor C2 has probably failed by open-circuiting.

Explosion Resisting ELECTRICAL EQUIPMENT

Industrial Multi-breaker, with arrangements up to 8 single poles, 15-50 amp., 250 volts A.C.

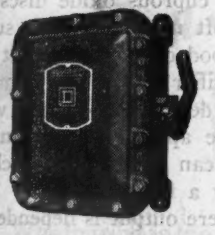


Industrial Circuit Breaker, 15-50 amp., 250 volts A.C. and 125/250 volts D.C., 600 volts A.C. and 250 volts D.C.

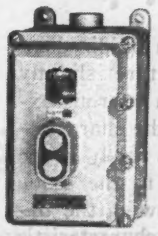


Industrial Circuit Breaker, 50-225 amp., 250 volts A.C. and 125/250 volts D.C., 600 volts A.C. and 250 volts D.C.

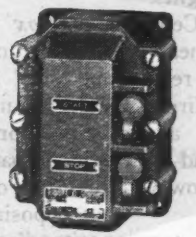
Industrial Circuit Breaker, 225-600 amp. (same voltages).



Type A (not fusible) Switches 30-200 amp., 575 volts A.C., 600 volts D.C.

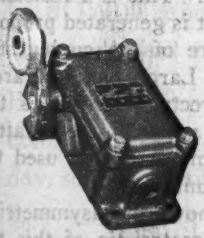


Class 2510 Manual starters for single or three phase motors. Built in NEMA sizes O and I.

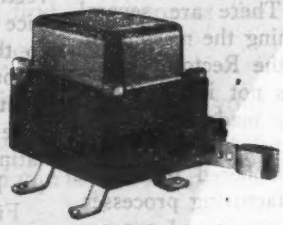


Class 9001 Push button stations up to 4 units heavy duty or 2 units standard duty construction.

Class 8536 Line voltage magnetic starters in NEMA sizes I, II and III for single, two or three phase motors.



Class 9007 Heavy duty limit switches for control circuit applications.



Class 9048 Float Switch—lever operated. Light duty, standard or reverse operation.

Class 9013 AR Pressure Switch—with or without release valve—available in a variety of ranges and also as vacuum switch.

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Electronic Auxiliaries—4

Batteries and rectifiers which are sources of direct current and their use in electronic circuits and apparatus.

By R. B. IMMEL

Westinghouse Elec. & Mfg. Co.
East Pittsburgh, Pa.

5. *Battery*

The battery, an assembly of cells which produce electrical energy by chemical means, is often used as a source of direct current potential. The small flashlight cell is a very common application of this type of voltage source. A series or parallel combination of cells which is called a battery is often applied to devices which are portable, such as test circuit lights, testing apparatus, and radio sets. Cells or batteries are often applied to measuring bridges or devices where a reliable and pulsation-free source of direct current is required. Batteries are often used for the emergency stand-by power supply in case of other power source failure.

A common type of dry-cell is shown by Fig. 20. This cell, despite its name, will not function when it is completely dry, is composed essentially of a carbon positive electrode, a zinc negative electrode container, and a moist paste of ammonium chloride and manganese dioxide. When a circuit between the zinc case and the carbon rod is completed, a chemical action between the zinc and the electrolyte (moist ammonium chloride paste) liberates positive zinc ions which go into solution. As a result of the zinc case or electrode losing its positive ions, it has a negative charge. The electrical energy is produced by chemical action, and eventually the zinc will be disintegrated. This type of cell is usually discarded when it is no longer chemically active as it cannot be recharged like a lead storage battery which operates in a slightly different manner.

Other types of cells and batteries, such as the rechargeable lead storage battery, are available. However, the particular application and duty determines their use.

6. *Rectox (Rectifier)*

When copper has been oxidized on one side at a temperature slightly under its melting point, a cuprous oxide will form which has the characteristics of passing electrons freely in the direction of the copper to the oxide but opposing electron flow in the opposite direction. This characteristic of a low resistance in one direction and a high resistance in the other makes it suitable for use in rectifying alternating currents. There are several theories for explaining the mechanism of rectification in the Rectox. However, the theory is not important as applications can be made very satisfactorily without that knowledge. It need only be remembered that as a result of the manufacturing processes, a combination of copper and cuprous oxide is formed in which it is relatively easy for the electrons to leave the copper and pass into the oxide, but quite difficult for them to escape from the oxide and pass into the copper. (Note that the conventional current flow in the external circuit is from positive to negative. This current flow direction is opposite to the actual direction of electron flow.)

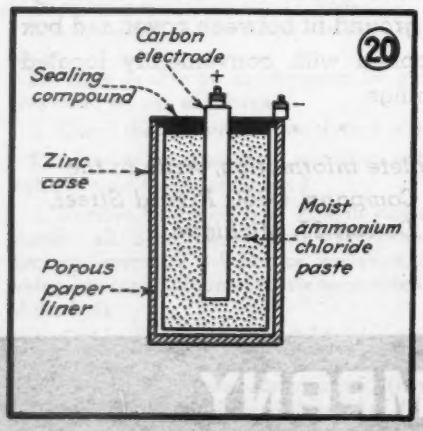


FIG. 20. Dry cell

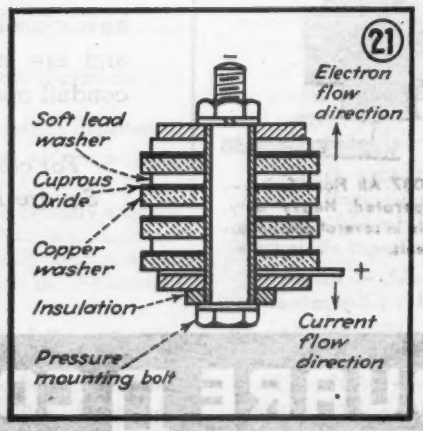


FIG. 21. Copper-oxide rectox rectifier

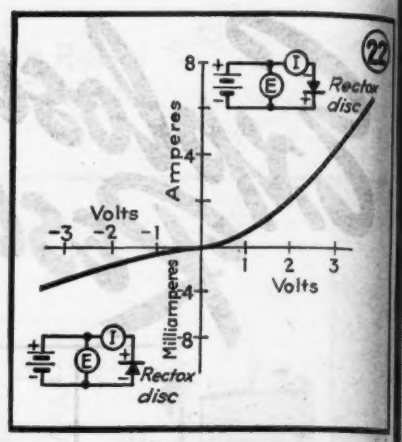


FIG. 22. Volt-ampere characteristic of a typical rectox single disc

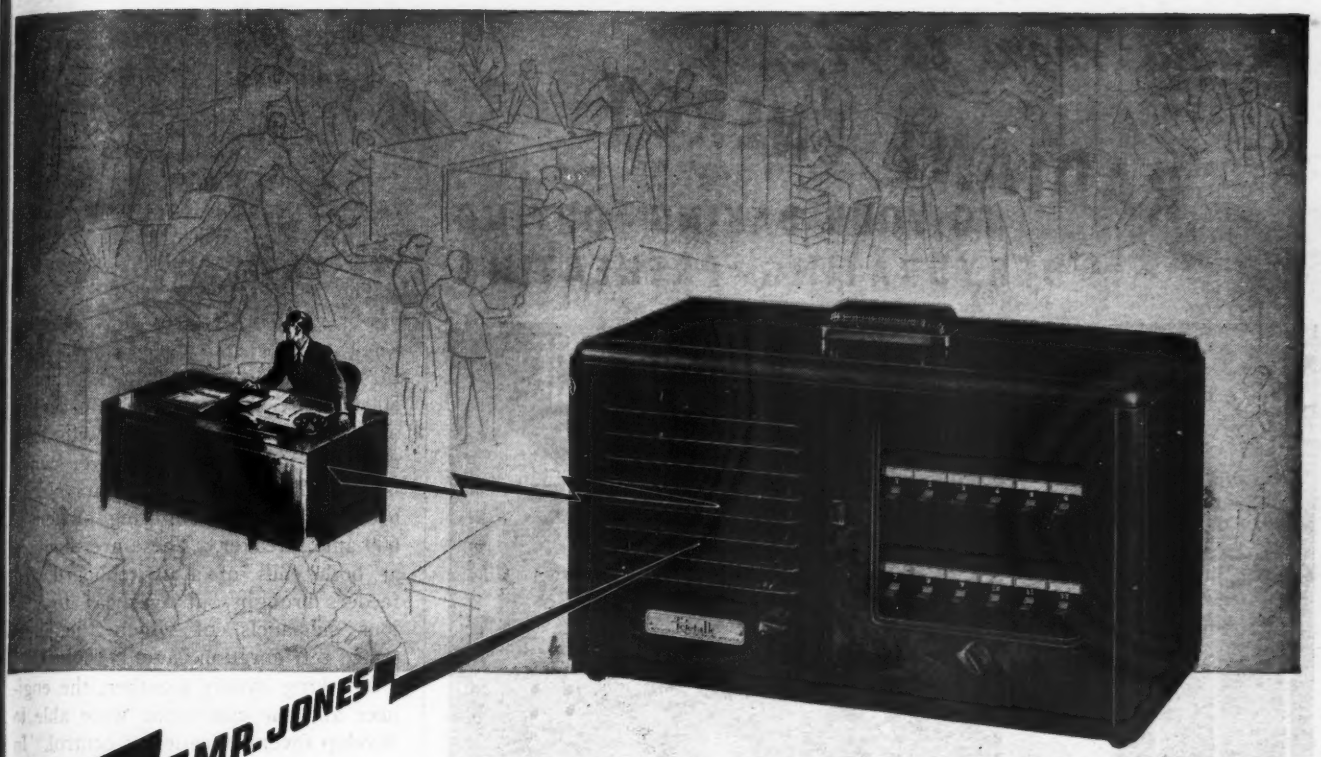
As shown by Fig. 21, an assembly of copper and cuprous oxide discs separated by soft metal washers, such as lead, for good contact are built up to form a rectifier unit. The number of discs used depends upon the voltage that will be applied to the unit. A single disc can withstand a back-voltage of only a few volts.

The ampere output is dependent upon the disc area and cooling means. Metallic plate cooling fins are often used to help dissipate the heat from the rectifier unit. This is a resistance device and heat is generated proportional to the square of the current flowing through it. Large rectifiers are often built with rectangular plates to provide a large area. Forced draft ventilating systems are often used to cool the Rectox units.

Fig. 22 shows the asymmetrical resistance characteristic of this type of rectifier. This unit is dry and is very strong mechanically. Also, it does not require a starting or warm-up period.

Rectox rectifier units are often used for the direct current power source of the ignitor circuit of an ignitron tube. It is suitable for high voltage applications and also for low-voltage and high-current circuits such as employed for charging batteries.

As shown by the characteristics in Fig. 22, when the rectifier is properly connected to an alternating current source, it will pass many amperes when the impressed voltage is positive (that is during the positive half cycle) and only a few milliamperes when the impressed voltage goes negative. Thus a rectified direct current is obtained, and although it has pulsating characteristics, these can be smoothed into steady direct current by choke and condenser filters if necessary.



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Wiring for Cleanliness

[FROM PAGE 87]

material for the job. This proved a great advantage in that the work could proceed without delay whenever it was necessary.

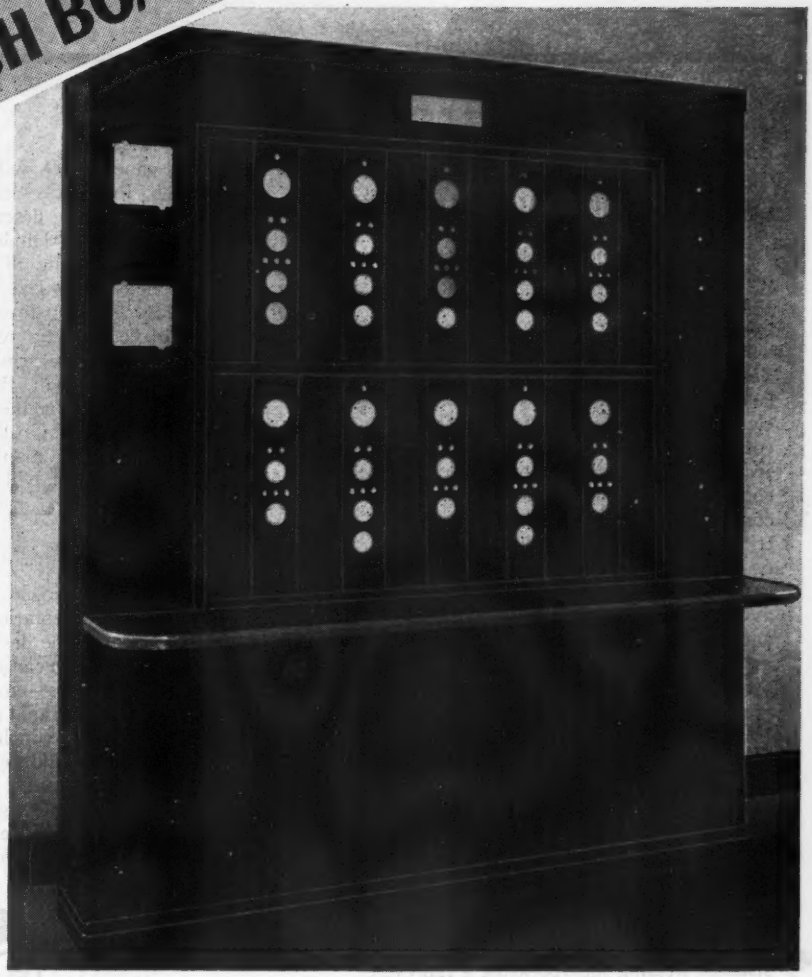
The main service comes from a power company transformer bank on a pole outside, into the basement in 3-in. conduit, using multiples of three 500,000-cir. mil cables in order to obtain maximum capacity with least reactance loss. The main power switch is a 1,600-amp. I-T-E air circuit breaker, the main lighting switch is 600-amp. breaker. These are mounted at both ends of a switchboard and feeders brought out overhead to various subpanels, of which the illustrated refrigeration panel is typical.

Working closely together, the engineer and the contractor were able to develop several niceties of control. In one instance a capping machine makes use of a microswitch to shut the machine down, should one of the caps fail to have in it the treated cardboard lining. The microswitch is set for the thickness of the paper liner and its absence shuts off the current through relays.

The electrical work was supervised by Roy Stolper and run by Roy Schlueter, foreman for Stolper Electric, who remained with the Kraft company as maintenance engineer upon completion of the job.

NEW PRESIDENT of the Southeast Texas Chapter, NECA, is Charles E. Seiders, Seiders-Schnorbus Co., Houston, Texas. His company has executed some of the larger industrial and government wiring contracts in that area.

Remote Control BENCH BOARDS



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for one of the large power companies serving the industrial middle west

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WRITE FOR BOOKLET—"DATA ON KIRK & BLUM PRODUCTION FACILITIES"

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IN THE NEWS

A. I. E. E. SESSIONS EMBRACE INDUSTRIAL FIELD

Encouraging evidence that the activities of the American Institute of Electrical Engineers are broadening out to encompass the problems of the industrial field was apparent at the Summer Technical Sessions at St. Louis, June 26-30, 1944. Conferences of interest to the industrial electrical engineer as well as the electrical contractor covered such prominent subjects as electric welding feeders and controls; electronics in power; industrial control; industrial plant low-voltage distribution; electric house heating; and subcommittee reports on the electrical applications and hazards on the farm as well as wiring in general. That this expanded agenda met with the approval of the 1200 members registered at the meeting was apparent from the unusually large number attending these specific sessions.

Electric Welding

Papers presented at this session included a description of the design and construction of a "kickless" water-cooled welding cable (paper 44-101) by Myron Zucker, M. G. Rees, Inc.; and a description of the design and operation of an improved electronic control for capacitor discharge resistance welding incorporating a full cycle discharge (paper 44-125) by H. J. Bichsel and E. T. Hughes, both of Westinghouse. Considerable discussion ensued comparing the merits of this new method with the shunt-tube scheme.

Three engineers of the E. G. Budd Company, C. A. Adams, J. R. Fletcher and A. C. Johnson, presented a paper (44-105) covering mathematical analyses for the determination of probable maximum equivalent continuous current for banks of a.c. resistance welders and the design of a bus system giving not over five percent voltage drop. The bus, now in operation at the Budd plants, is a new totally enclosed unit with busbars only ⅛-inch apart to minimize reactance losses. In a prepared discussion of this paper, L. W. Clark, Detroit Edison Company, offered a simplified method of determining the probable maximum equivalent continuous welding current based on actual field test and calculated data. By his method, the probable maximum equivalent continuous welding current of a bank of welders is the sum of the equivalent continuous current (equal to the maximum current times the duty cycle of the welder) of the largest welder and 60 percent of the sum of the equivalent continuous currents of the other machines in the group.

In a conference paper, R. O. Askey and E. R. Hendrickson, Public Service Company of Northern Illinois, described a "voltage translator" scheme employed to successfully eliminate lighting flicker on utility lines serving industrial welder loads. The translator (a transformer and constant current street lighting regulator combination) operates on the principle of interposing an impedance in the line, through a transformer arrangement such that the voltage drop through this impedance caused either by the main feeder load or the fluctuating load will appear as a voltage rise to the other load.

Industrial Control

F. H. Holt, General Electric Co., opened this session with the presentation of a paper (44-142) describing the design and operating problems of modern cargo winch controls used on Victory ships—embracing problems of speed range for rapid acceleration and deceleration of winch loads. Two General Electric engineers, G. F. Leland and L. T. Rader, presented a paper (44-141) outlining a simple graphical method of determining the required shunt and series resistances for shunted-armature connections for d.c. shunt motors to obtain good speed regulation at low cost.

In view of the possibilities of new synthetics and past experience with 85 and 100 degree C. rises in temperatures, B. W. Erickson, General Electric Co., (paper 44-140), recommended 100 and 120 degree C. rises as insulation temperature standards for industrial control coils for 600 volt rating or less.

Which presents the best short circuit protection to low-voltage a.c. and d.c. starters—fuses or circuit breakers? B. W. Jones, General Electric Company, (paper 44-139) gave the answer. Based on his investigations he concluded that, with starters in series with the protective device, fuses are the only satisfactory available means to fully protect small size starters from short circuits—since circuit breakers provide a slower interrupting means.

Electric House Heating

Two separate sessions were devoted to this subject—the first investigating theory and application; the second actual experiences in the field. Electric panel space heating—an adaptation of the incandescent

"Deadest bunch of old fogies I ever saw!"

. . . . Still Supreme

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AVAILABLE TYPES, SIZES
LOW MAINTENANCE

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The very unit upon which Curtis Lighting has built their reputation for almost one half century continues to be your best choice for any high-bay or industrial lighting job you are apt to encounter. Whenever specifications demand the most useful light per dollar at the lowest maintenance cost you will always win out with the Curtis X-Ray Silver Mirror Reflector.

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source method using a large area radiant source at low temperature—was described by B. F. Raber and F. W. Hutchinson, both of the University of California (paper 44-154) who developed a load calculation procedure for such installations. The paper revealed that from 1938 to 1941 some 200 such installations were made in the U. S.

Electro-thermal space heating and air conditioning systems—incorporating heat storage units using off-peak energy—were described by George H. Krueger, Bonneville Power Administration (paper 44-155). Cost estimates for converting a six-room dwelling hot air heating system to the electro-thermal type approximated $600. Advantages listed were continuous heat supply, cleanliness, no fire hazards, simplicity and minimum space requirements (true of most all electric heating systems).

Heat pumps—refrigeration systems where heat given off by the condenser is utilized—present another possibility of heating homes believes R. U. Berry, General Electric Company (paper 44-156). Although believing them feasible for heating industrial and commercial establishments, he predicated their adaption to home heating on the promotion and acceptance of air conditioning systems in the home.

Highly interesting statistics on the application of electric heating to small homes in the Tennessee Valley area were presented by B. H. Martin, T.V.A., in a comprehensive conference paper outlining his experiences in this field. Figures on a group of 30 houses ranging from four rooms (6,240 cu. ft.) to nine rooms (11,922 cu. ft.) in size revealed an average connected heating load of 3.67 KW per room or 2.18 watts per cu. ft. (1,685 cu. ft. per room average). Annual average kilowatt-hour heating consumption was 1.35 per cu. ft. or 2,274 per room at an annual heating energy cost of $12.40 per room. Typical design consisted of one electric heater (concealed under windows) per room, each equipped with a thermostatic control.

Industrial Distribution

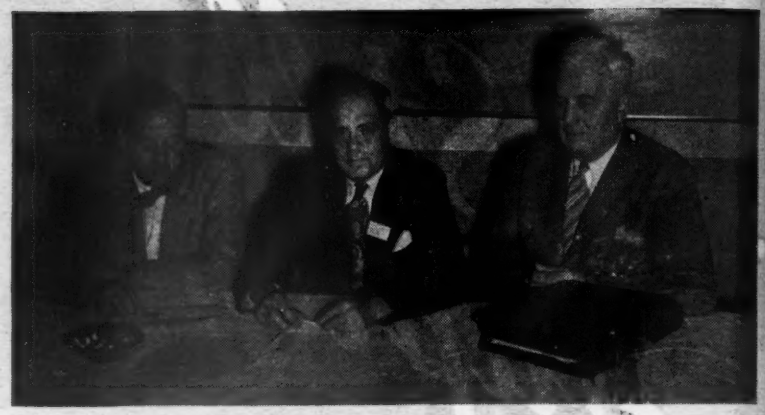
Highlight of this session was the presentation of the report on electric power distribution for industrial plants by the Committee on Industrial Power Applications. The 220 page report, outlined by John Grotzinger, chairman of the committee, covers a subject range from estimating load for new plants, calculating fault currents, power factor, to selection of equipment and actual system design. This comprehensive work is intended as a manual on industrial electrical system design and will be published and sold through A.I.E.E. this fall. Comments from those present and engineers who had previously reviewed the report, page by page, were highly commendable.

Automatic switching of shunt capacitors on plant feeders to eliminate excess capacitor kvar at light loads was described by W. H. Cuttino, Westinghouse, (paper 44-178). By use of this automatic method of switching capacitors on and off, the benefits of adding units to supply kilovars up to full load conditions can be obtained and their usefulness increased, he concluded. A second paper on the same general subject (paper 44-173) presented by T. W. Schroeder and W. C. Bloomquist, General Electric Company, offered application information as a guide to the selection of proper automatic control and switching equipment for capacitor banks.

Concluding this session was a conference paper by E. L. Bailey, electrical engineer, Chrysler Corporation, describing the installation and operation of the power recovery system at the Dodge-Chicago plant wherein generators coupled to airplane engines on test pump electrical energy back into the plant distribution lines.

Electronic Converters

A series of five papers (44-143 to 44-147) on electronic power and frequency converters were presented in a symposium on this subject. Outlined in detail was a description of the installation and operation of the first 20,000 KW electronic power converter at the Edgar Thompson Plant of the Carnegie Illinois Steel Corporation to exchange power between their 25 cycle, 44 KV and 60 cycle, 69 KV systems.



NEW OFFICERS of the Tennessee Electrical Contractors Association, elected at the recent meeting in Memphis, are (L to R) first vice-president, W. G. Hoffman, Knoxville; president, A. C. Gross, Memphis; and secretary-treasurer, Philip Sweet, Chattanooga.

I.B.E.W. TO TRAIN ELECTRONIC SPECIALISTS

A determination to see that its members fit into the postwar progress in the electrical field was apparent in the recent announcement by the International Office of the International Brotherhood of Electrical Workers of plans to train its members in the field of electronics. Crux of a comprehensive training within the ranks program is a series of eight intensive courses, each of six weeks duration, to be given chosen members of the locals at Marquette University in Milwaukee, Wis.

Under cooperative arrangements with Marquette (chosen because of its central location for members from all parts of the United States and its past experience in working with industry) some 80 to 85 Journeymen electricians from all parts of the country will be trained at each course—tuition to be defrayed by the International Office of the Union. Travel and living expenses (in hotels near the college) will be defrayed by the student, or his local union, or both—this being a matter of local decision.

Eligibility standards for students require that they must be Journeymen preferably with a knowledge of the equivalent of high school mathematics (not an absolute requirement); with the ability of getting along with others and to be a leader; with foreman's training or teaching experience on the job a definite asset. Each local union chooses the man (or men) whom it desires to take the course, files his name with the International Office. When the first 85 men have been selected they will be notified and entrain for Milwaukee. The first class of electricians will probably enter Marquette in the fall, for six weeks of intensive study. Other groups will follow at six-week intervals.

Teaching personnel will be made up of Marquette faculty together with manufacturers' engineers and union members who have had the necessary background in electronics. Subject matter will cover the elementary theory of electronics with the major portion of the course devoted to the practical side encompassing extensive laboratory work and, through the cooperation of Milwaukee industries, inspection trips to plants using electronic equipment where the men can get first hand information on the application, operation and maintenance of such equipment.

The training within ranks portion of the program begins when the first class has successfully completed the Marquette course. These men can then go back to their local unions and, using the well known Westinghouse Course on Electronics, each teach from 25 to 30 fellow members.

With this plan in operation, I.B.E.W. hopes to give its members the necessary background and "know how" to enable them to understand, install and maintain electronic equipment in the future, and keep pace with advances in the field.

How it was done with
CENTRAL RIGID STEEL CONDUIT

Here's another fine example of engineering "Know How," carried out with Central Rigid Steel Conduit.

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GET *all* the usefulness out of your Blackhawk Porto-Power Pipe Bender! Sure, it bends pipe up to 4 in. Also, it can be removed from the bending frame to serve as a powerful jack—or with standard attachments to pull, push, spread, press, lift and lower—easily, accurately, safely and fast!

Porto-Power is fast becoming indispensable hydraulic service equipment in maintenance and electrical work, production plants, shipyards, construction companies and repair service organizations.

If you have a Blackhawk Pipe Bender be sure you know *all* its uses. If you'd like to have one, call your industrial supply distributor or write Blackhawk for complete information on Porto-Power in 7, 10, 20 and 50-ton capacities.

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Rush new Hydraulic Equipment Bulletin V-43 to us.

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P. C. E. A. DEVELOPS ADEQUATE WIRING APPRAISAL CHART

To see to it that sufficient money is allowed in a home building loan for the installation of an edequate wiring job, an adequate wiring appraisal chart has been developed by the Pacific Coast Electrical Assn. and is now being distributed to the banks, building and loan companies, FHA appraisers, real estate and other persons influencing the building of homes in California. Its purpose is to enable the appraiser or loaning agency to determine what portion of the total loan should properly be assigned to the electrical work in order to guarantee an adequate wiring job. Along with the chart these agencies are being sold the idea that the wiring installation dates the house and will have a material influence on its future resale value over long-term amortization period.

After considerable work by the committee it was decided to base the chart on a typical small two-bedroom home of one story, 1,200-sq.ft. type and to cost a maximum of about $6,000. The estimates are based on those provided by electrical contractor members for a job done to adequate wiring or Red Seal specifications. This estimate is based on an electrical contractor's estimate of $240 or four percent of the building cost.

The job is broken down on a basis of points and each point is assigned a value of 24 cents or 18 cents depending on whether the job is in rigid conduit or in other approved wiring methods. Various portions of the job are assigned points. Additional wiring, likewise, has a list of values and the appraiser is given instructions for applying these to the plans and specifications submitted to him.

ADEQUATE WIRING APPRAISAL CHART

FOR USE IN DETERMINING THE LOAN VALUE OF THE ELECTRICAL WIRING IN RESIDENTIAL OCCUPANCIES

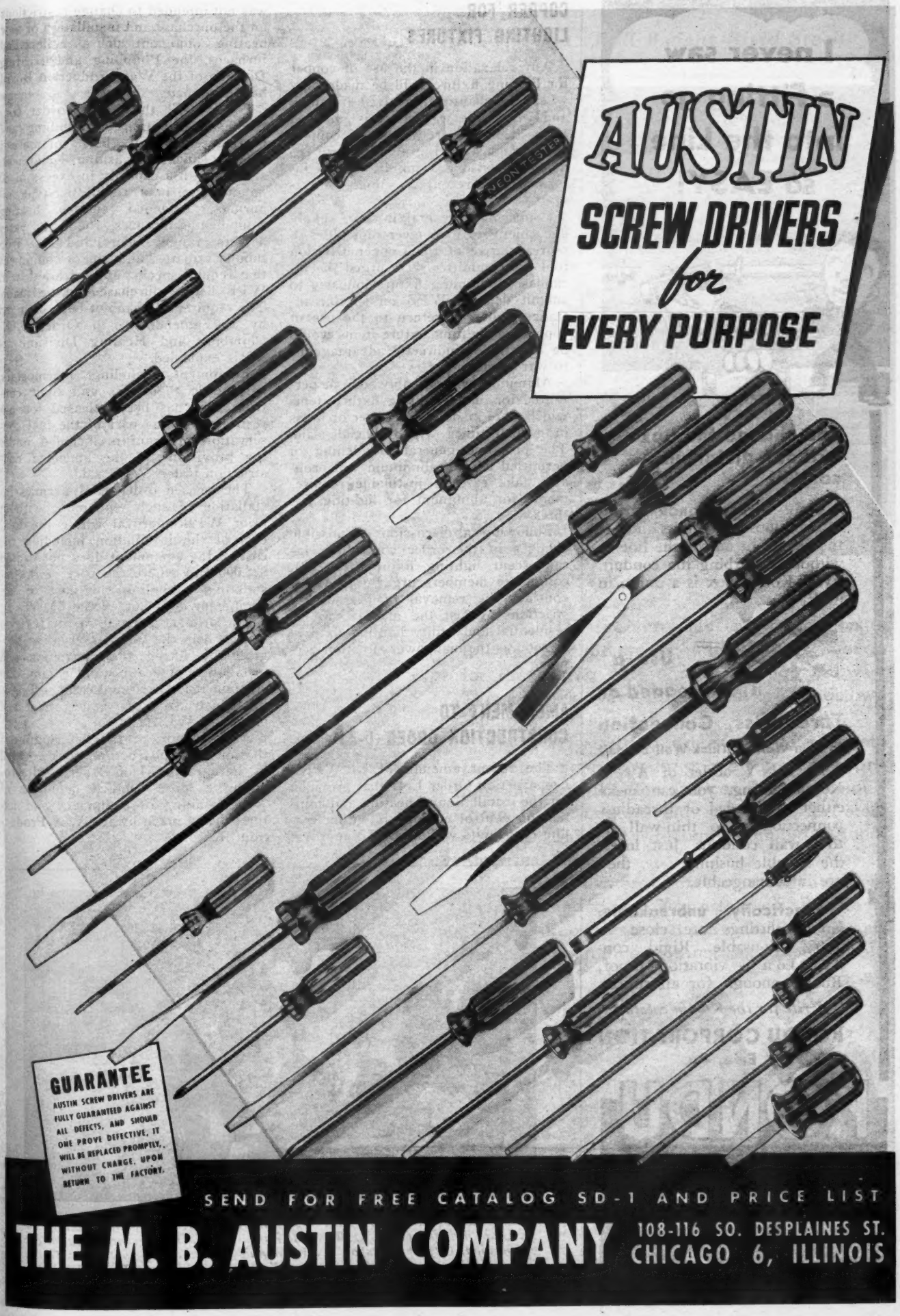
Based on a typical one-story, two-bedroom home. Approximately 1200 sq. ft. Cost about $6,000. Minimum wiring installation. (Red Seal Specifications.) Normal job considered 1000 points. Electrical Contractor's Estimate $240 or 4% of building cost. On this basis each point is 24¢ or 18¢.	Rigid Conduit	Other Approved Methods
UNIT VALUE OF THE VARIOUS PARTS OF ADEQUATE WIRING SPECIFICATIONS		
	Points	**Cost**	
Main service, service entrance equipment, capacity for lighting and convenience outlets only.....	125	$30.00	$30.00*
Lighting: 15 lighting outlets on 2 branch circuits of #12 wire.....	125	30.00	22.50
Switches: 10 single-pole, two sets 3-way switches and wiring (each 3-way switch figured as 3 outlets).	125	30.00	22.50
Convenience Outlets: 21 convenience outlets on 2 branch circuits of #12 wire.....	175	42.00	31.50
Door Bells: One front door, one service door. Bells, wiring, and transformer.....	25	6.00	6.00*
Range Wiring: Range circuit and receptacle; increased service and protective equipment.....	225	54.00	40.50
Water Heater: Heater circuit (heater not included).	100	24.00	18.00
Bathroom Heater: 1500-watt heater and wiring...	100	24.00	24.00*
	1000	$240.00	$195.00
FOR ADDITIONAL WIRING			
For each additional lighting or switch outlet add...	15	3.60	2.70
For each additional convenience outlet add.....	20	4.80	3.60
For each additional bathroom heater add.....	100	24.00	24.00*
For each additional room (light outlet, switch, and 3 convenience outlets) add.....	90	21.60	16.20

For the Appraiser: * Cost is same in either case.

This size and value of home represents the largest percentage of new homes built. The electrical installations proposed are the minimum under Adequate Wiring Standards. There will be two lighting circuits, two convenience outlet circuits, one installed 1500-watt bathroom heater, wiring only for an electric range and wiring only for an electric water heater.

The "points" value is a fair division of the total cost into the component parts of this installation. The "points" given for additional outlets represent the greater costs in a home of larger floor area. These should be used for additional rooms.

Owing to local ordinance requirements in some areas regarding wiring methods permitted, the appraiser should obtain contractor estimates on the required minimum in areas where such restrictions prevail. Using these figures, the "points" value would still represent the proportionate values and should be used. Prepared by the Adequate Wiring Committee of the Pacific Coast Electrical Ass'n.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Use a *Threaded* or *Threadless* Connection

to Thin-Wall or Thick-Wall conduit

At ANY outlet of ANY Kondu fitting, you can make either a threaded or threadless connection — to thin-wall or thick-wall conduit. Just insert the suitable bushing . . . they are interchangeable.

Practically unbreakable, Kondu fittings are close to 100% re-usable. Rigid connection is vibration-proof. Roomy enough for all splices.

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COPPER FOR LIGHTING FIXTURES

Any relaxation in the use of copper for lighting fixtures will be made only where the quantities involved are small and where the war effort is impeded by restrictions on the use of copper, the Incandescent Lighting Fixture Industry Advisory Committee was informed at its recent Washington meeting.

Copper is, in general, in short supply due chiefly to manpower difficulties, a representative of the Copper Division told the committee. He urged the incandescent lighting fixture industry to submit data to WPB on specific instances where a return to the use of copper for lighting fixture items would be directly or indirectly advantageous to war production.

Aluminum will probably soon be permitted for many lighting fixture items which were made from copper or brass in normal times, WPB officials said. The proposed general broadening of permitted uses of aluminum will probably take care of justifiable requirements for aluminum for lighting fixtures.

Following a discussion of possible changes in the order controlling incandescent lighting fixtures (L-212), committee members urged that WPB consider the removal of present restrictions against the manufacture of residential and utility lighting fixtures as soon as the manpower situation permits.

AMENDMENT TO CONSTRUCTION ORDER L-41

The recent amendment to WPB's Construction Order L-41 that provided for the installation of heating and combustion control equipment within certain cost limits without WPB approval was not intended to change restrictions on the purchase and installation of new heating equipment such as boilers and furnaces, the Plumbing and Heating Division of the War Production Board has explained.

Order L-79, the general order controlling distribution of plumbing and heating equipment, lists commercial cooking and dishwashing equipment, stokers with a capacity in excess of 60 pounds per hour, domestic type oil burners, extended surface heating equipment, furnaces, boilers, water heaters, range boilers and cast iron tubular radiators as items of equipment that require specific authorization from WPB before purchase can be made. The requirement has not been changed by the amendment to Order L-41, Plumbing and Heating Division officials explained.

Equipment including thermostats, barometric regulators and limit controls, that has been released for unrestricted sale as part of the fuel conservation program is included under the provisions of the amended construction order, WPB said.

The revised order L-41 permits installation of such equipment without prior WPB approval where the total cost of the installation including the cost of the equipment does not exceed $25,000 and where the cost of the installation excluding the cost of the equipment does not exceed $5,000.

The primary purpose of the revision was to help the fuel conservation program by lifting the restrictions on installation of heating and combustion equipment for existing heating systems in industrial plants and commercial buildings, WPB said.

Amplification of the description of the kind of construction work covered by Paragraph (b) of Order L-41, providing a more detailed definition of "the installing of equipment and fixtures," was made by the War Production Board.

MIDWEST NECA CHAPTER representatives at recent special meeting in St. Louis included (L to R) Wm. McGuineas, president, Electrical Contractors Association, City of Chicago; W. T. McAuley, Kansas City contractor; G. V. "Denny" Dameron, secretary, Greater Kansas City Chapter; E. H. Herzberg, manager, Milwaukee Chapter; and E. L. Santschi, Chicago, mid-western representative, NECA.

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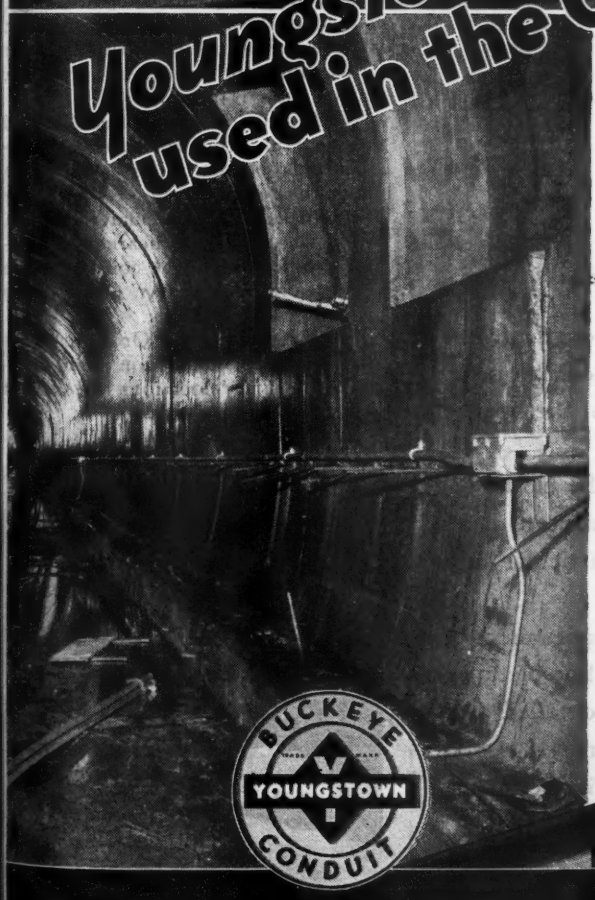
For years, owners, contractors and dealers have depended on Youngstown Buckeye Conduit--knowing that it provides the best and cheapest insurance against hazards, trouble and expense.



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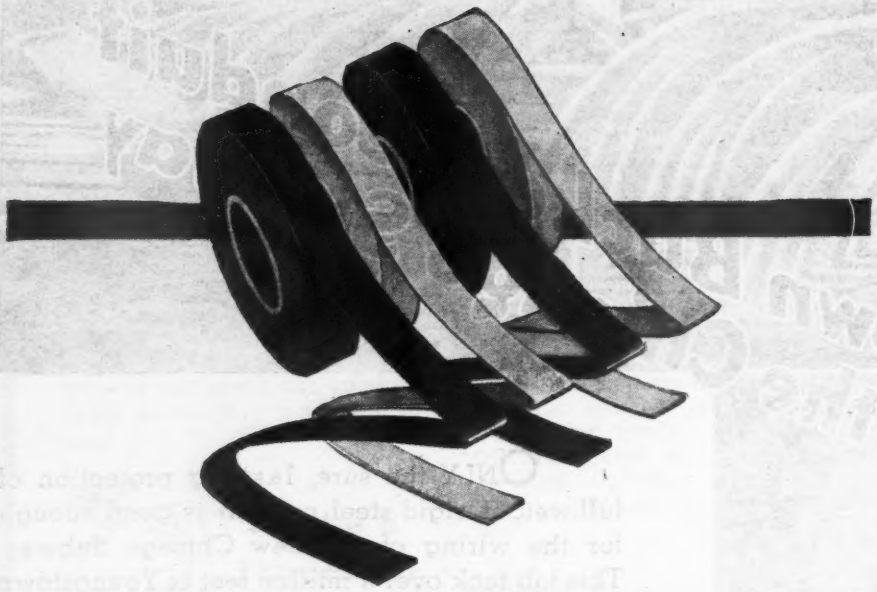
What to Look for in INSULATING TAPES



Check these facts when selecting insulating tape:

A. The base cloth must: (1) have ample mechanical strength; (2) be chemically inert: (3) contain minimum sizing to permit thorough penetration by the insulating varnish and prevent weakening of the fiber in service.

B. The varnish must: (1) be neutral in relation to the cloth; (2) impart maximum dielectric strength, flexibility and resistance to heat, oil, water or other damaging agents against which the particular tape is to give protection.

C. A ready source of supply for all types of insulating tapes must be available. Your local G-E distributor handles a complete line of tapes, as well as all other insulating materials, and can furnish detailed data and catalog on request. Or send for catalog to Section M844-8, Resin and Insulation Materials Division, General Electric Company, Schenectady, N. Y.

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This action was accomplished by issuance of Interpretation 9, which specifically states that certain kinds of installation are construction and are governed by the restrictions of L-41. The following kinds are listed:

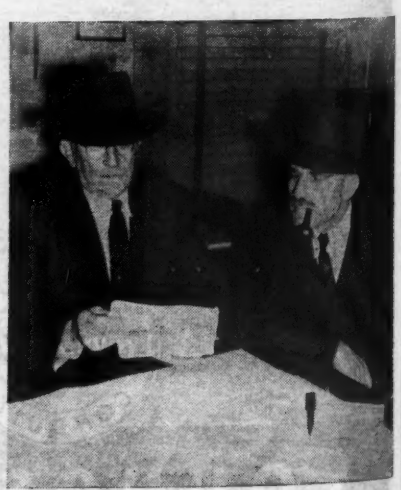
"The installation of any piece of equipment or fixture which is attached to the plumbing system of a building; the installation of any piece of equipment or fixture which involves putting new wiring in a building; the installation of any piece of equipment or fixture for which a base or foundation must be built; the installation of any piece of equipment or fixture cemented to a floor or wall of a building; the installation of a furnace or stoker connected by pipes or flues or wiring to the building."

The following kinds of installations are not considered construction under L-41:

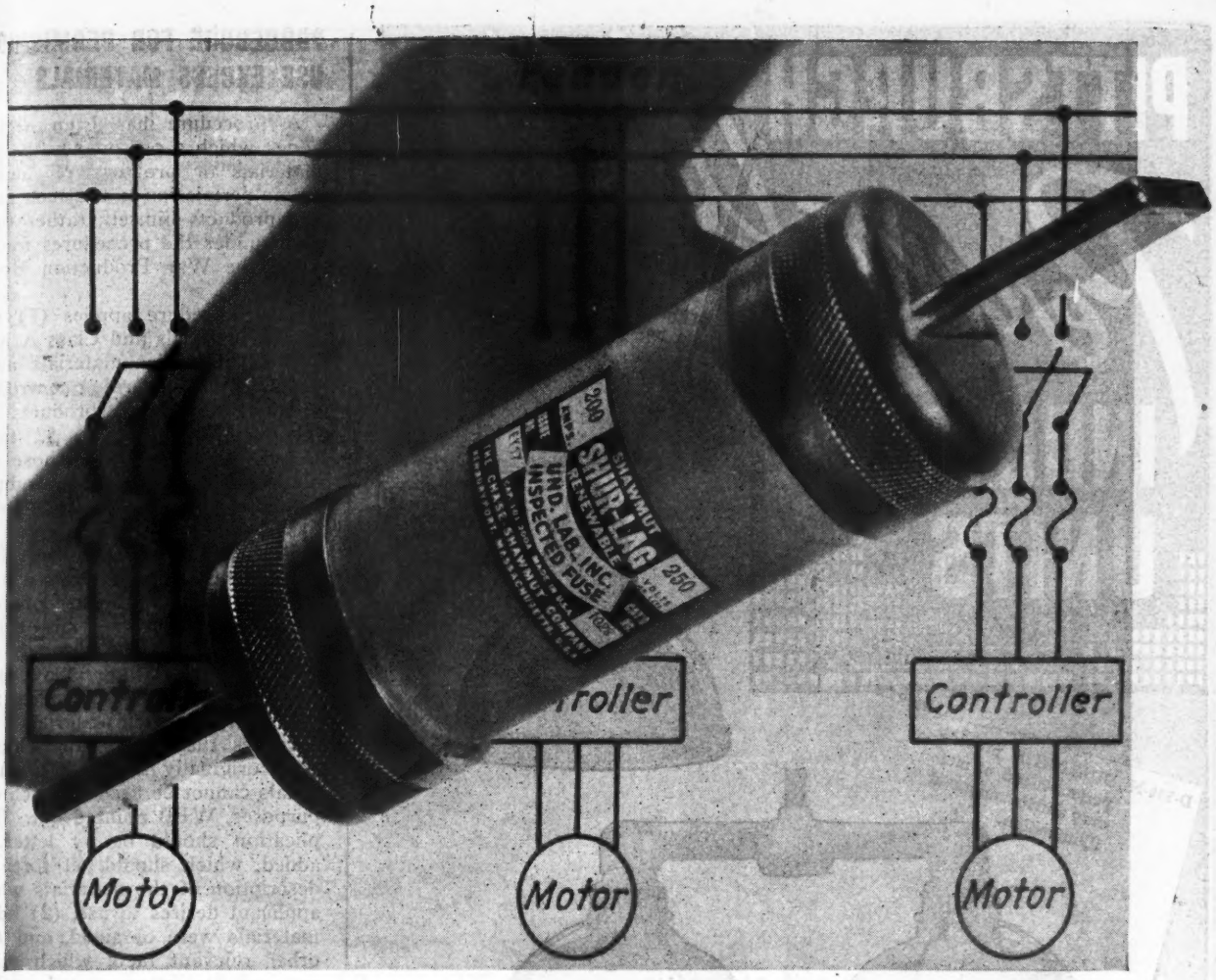
"The installation of a counter, table or booth which is attached to the building only by nails or screws and which can be removed as a unit and will only make it necessary to fill up the holes left by the nails or screws (however, if the counter contains equipment which is attached to the plumbing system, construction is involved); the installation of a piece of equipment or fixture which requires only making a connection to an existing wiring outlet (if new wires must be run or a new outlet built into the wall or ceiling, construction is involved)."

WPB said these examples illustrated the general principals concerning installations constituting construction under the restrictions of L-41. In case of doubt as to a particular installation, WPB suggested the nearest WPB regional office should be consulted or an application be filed for permission to proceed with the work.

Interpretation 8 to Order L-41 was also issued in connection with the installations and relocations of equipment in certain large plants.



PROMINENT in South Texas electrical contractor activities are (L to R) Temple Wheeler, business manager, and Fred R. Loth, president of the South Texas Chapter, NECA, at San Antonio. Mr. Loth heads up the Graham & Collins Electric Company of San Antonio.



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in an electrical circuit is protection for the circuit and for all the equipment on it. For this purpose there is nothing superior to

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Shur-Lag fuses are the simplest, sturdiest, and most serviceable time-lag fuses made, and the quickest and easiest to renew. They are the safeguard you should have to give your circuits full performance and protection at all times.

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I-1005-N with retaining ring.
D-530-N DUALIGHTS provide perfect blend of mercury and incandescent illumination.

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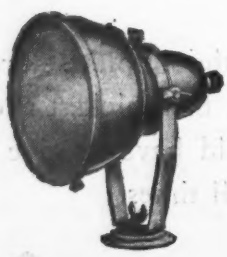
Rugged in construction · weather-proofed and corrosion-resistant · equipped with famous silver-mirrored glass Permaflectors. Available in 200 to 1,000 wattages, and broad, intermediate or concentrated light distributions. Complete. Ready to set up.



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PROCEDURE FOR PERMISSION TO USE EXCESS MATERIALS

A procedure has been established under which a person who has excess materials or products on hand may obtain permission to use such materials and products himself, rather than sell them under the procedures for special sales, the War Production Board reports.

The procedure applies (1) to controlled materials and Class A products and (2) to other materials and products. Rules governing controlled materials and Class A products are set forth in Direction No. 52 to CMP Regulation No. 1, while those governing other materials and products are contained in Direction No. 4 to Priorities Regulation No. 1.

Persons who have (1) controlled materials or Class A products which they obtained through the use of an allotment or (2) other materials or products which they obtained through the use of preference ratings, may apply to their nearest WPB field office for permission to use such materials for other purposes than those for which they were originally acquired, if such materials cannot be used for such original purposes, WPB pointed out. The application should be by letter, WPB added, which should set forth: (1) a description of the materials which the applicant desires to use, (2) how such materials were obtained, and (3) any other relevant facts which might be required for acting on the application.

WPB will grant permission for the use of excess materials under the following circumstances:

1. If the intended use of the materials would be permitted if the same materials were acquired through a special sale under Priorities Regulation No. 13.
2. If the use of the materials in production in any one plant, or the labor requirements for that production, will not interfere with war production in that plant or in any other plant located in the same area.

Both Direction No. 52 to CMP Regulation No. 1 and Direction No. 4 to Priorities Regulation No. 1 point out that authorizations which may be granted under their terms will not be exceptions to the provisions of any E, L, or M order or any direction issued under any such order.

INTERPRETATION NO. 13 CLARIFIES PR NO. 3

Rules governing the application or extension of preference ratings have been clarified with the issuance of Interpretation No. 13 to Priorities Regulation No. 3, according to the War Production Board.

When a preference rating is being

The New Model 710

VOLT — OHM — MILLIAMMETER

NOW AVAILABLE FOR PROMPT DELIVERY ON PRIORITY OF AA3 OR BETTER!!

Sensitivity—

1,000 OHMS PER VOLT
ON BOTH A.C. AND D.C.!!

Measures:—

A.C. AND D.C. VOLTAGES UP TO —
1500 VOLTS
A.C. CURRENT UP TO —
3 AMPERES
D.C. CURRENT UP TO —
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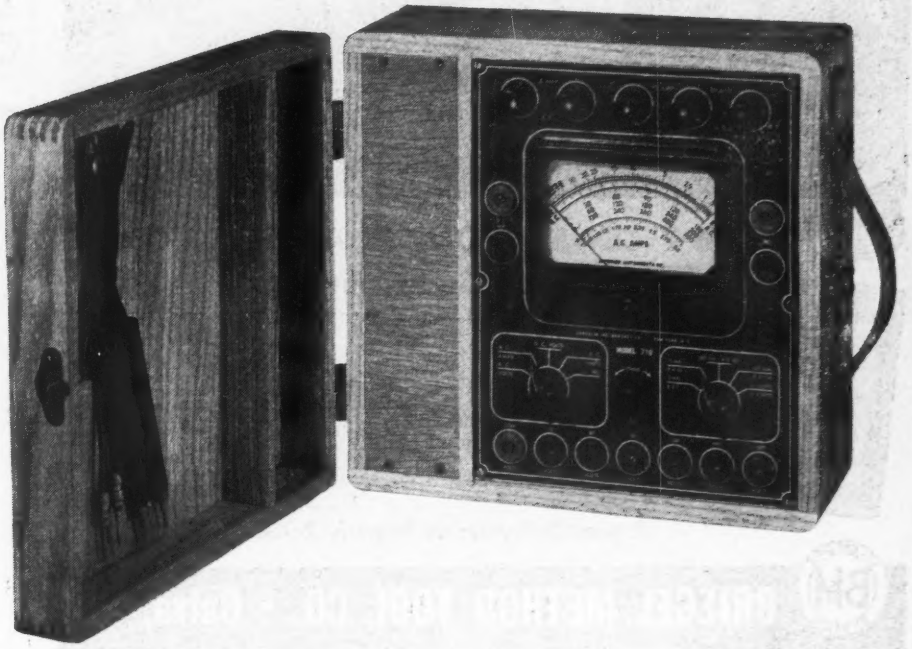
RESISTANCE UP TO —
10 MEGOHMS



Features:—

*Uses New 4½" Square Rugged 0-400 Microampere Meter.
*Direct Reading—All Calibrations Printed Directly on Meter Scale in Large Easy-to-Read Type.
*Housed in Rugged Heavy Duty Portable Oak Cabinet.
*Completely self-contained—No external Source of Current Required.

A 400 microampere meter movement is shunted to provide a sensitivity of 1,000 Ohms Per Volt on both A.C. and D.C. This method—using a 400 Microampere meter instead of a 1 Milliampere meter—affords improved damping because the meter is at all times shunted by a resistance. A Ayrton universal shunt is used for all current and resistance ranges. Paired multipliers insure accuracy of all voltage ranges and in addition two individual master calibrating adjusters enable precise calibration of all A.C. and D.C. Voltage Ranges. An almost perfectly linear A.C. scale is provided by using a special copper oxide rectifier unit which has an inverse to forward "a" resistance ratio of better than 400 to 1. Although the current carrying capacity of this rectifier is 15 ma., a maximum of 1 Milliampere is permitted to pass through the unit. This insures minimum heating in the rectifier unit guaranteeing high stability at all A.C. calibrations.

Specifications:—

6 D.C. VOLTAGE RANGES (1000 OHMS PER VOLT)
0 to 15/60/150/300/600/1500 Volts.
6 A.C. VOLTAGE RANGES (1000 OHMS PER VOLT)
0 to 15/60/150/300/600/1500 Volts.
7 D.C. CURRENT RANGES:
0 to 3/15/60/150 Milliamperes 0 to 3/15/30 Amperes.
A.C. CURRENT RANGE:
0 to 3 Amperes.
5 RESISTANCE RANGES:
0 to 1,000/10,000/100,000 Ohms. 0 to 1 Megohm 0 to 10 Megohms.

The MODEL 710 comes complete with cover, self-contained batteries, test leads and instructions. Size 6" x 10" x 10". Net weight 11 pounds. Price..... **$34.50**

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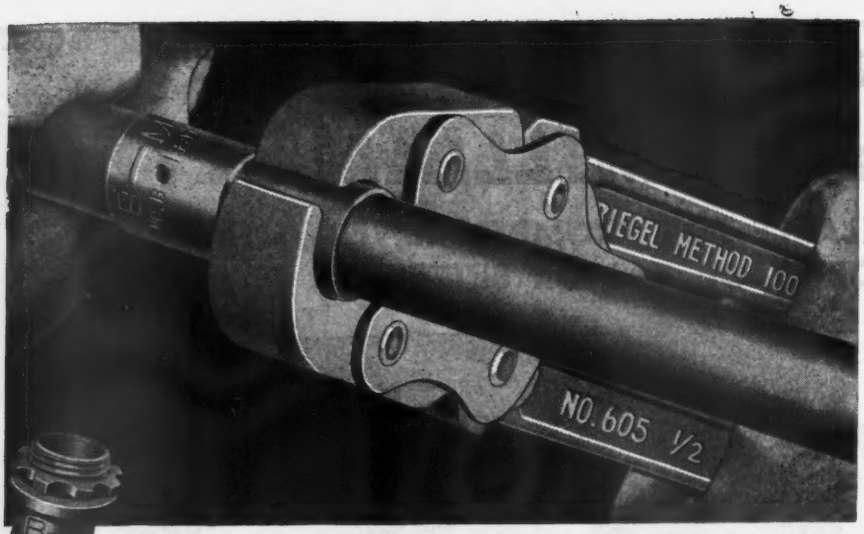

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TWO QUICK SQUEEZES give you Finer, Faster Conduit Connections. B-M Fittings do away with the twisting, turning and tightening of nuts and save you valuable time and materials. Then too, they are stronger, neater and much easier to work with in tight places. Start using B-M Fittings today. Have more satisfied customers—more profits from each job!

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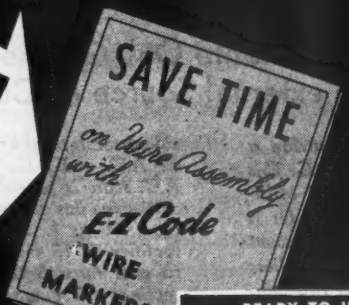

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E-Z CODE Wire Markers come on handy cards. They are simple to use, stick quickly, no moistening, stay on and stand abuse.

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applied, other than a blanket rating such as one assigned by Controlled Materials Plan Regulation No. 5, or when any rating is being extended for some purpose other than to replace inventory, it may be done only within a reasonable time after the rating was received. The general rule, according to Interpretation No. 13, is that more than three months is deemed to be an unreasonable delay in the use of a rating. However, in particular cases there may be circumstances which make a reasonable time shorter or longer than three months, WPB said.

The interpretation points out five specific cases to illustrate the application of specific circumstances to modify the general rules:

1. A rating assigned to a construction project on a form which indicates when a rating expires may be applied for material going into the project until the stated expiration date, even though more than three months may have elapsed. Such ratings are assigned on forms such as GA-1456 or CMPL-593.
2. A rating assigned in connection with an export license may be applied as long as the license is valid and expires when the license expires or is revoked. (For explanation of this rule see Interpretation 2, Directive 27.)
3. When a rating is applied to a long term contract (such as the construction of a ship), it may be extended for material needed to fill the contract, even though more than three months have elapsed.
4. If the purpose for which the rating was assigned no longer exists, the rating may not be applied even though three months have not elapsed.
5. When a rating is extended by a person to get material to deliver to his customer, or to incorporate in such material, the time within which it may be done will, in general, be controlled by the delivery date on his customer's order.

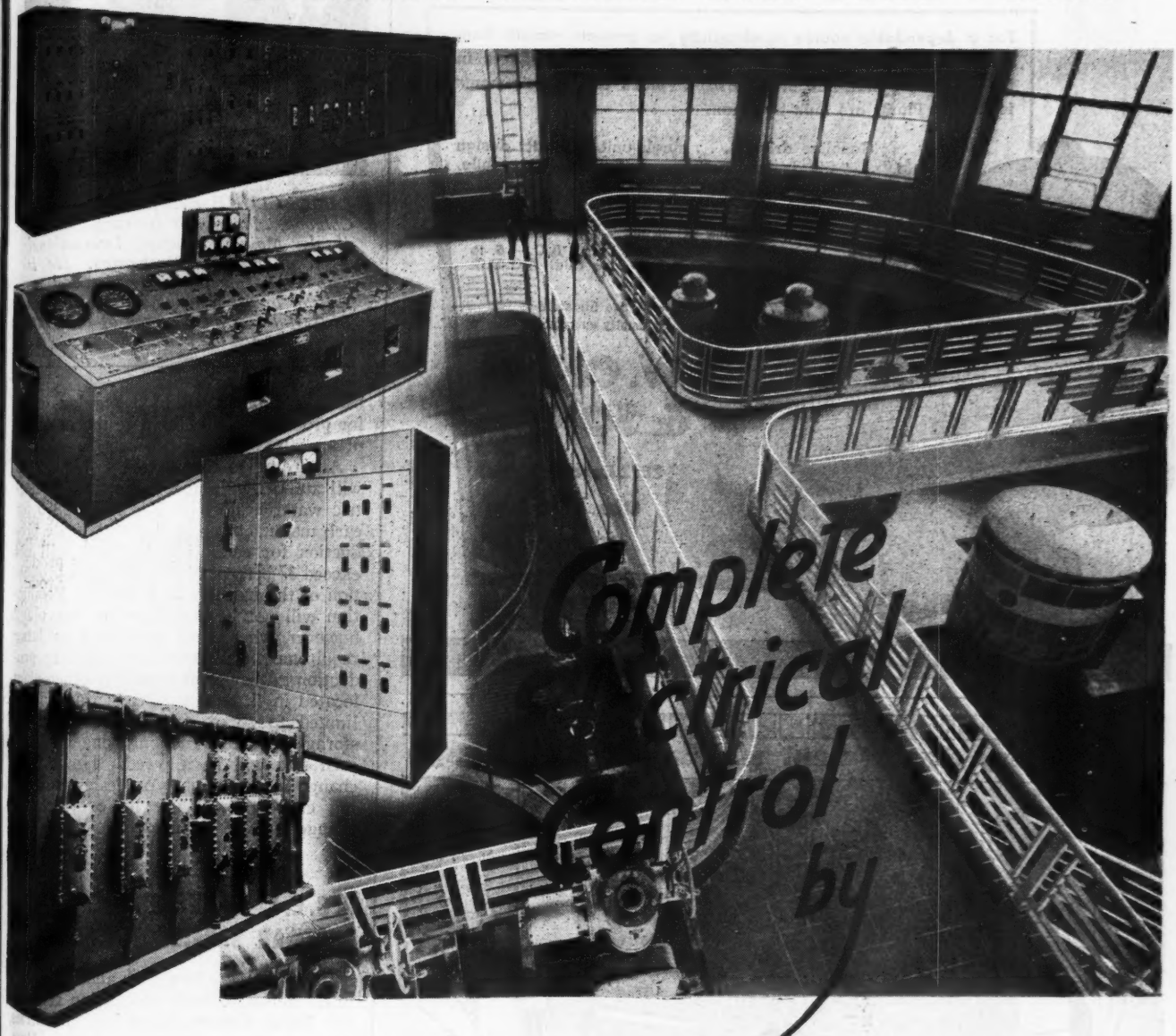
The interpretation finally points out that the mere fact that a person has not been able to get his rated order accepted by a supplier does not lengthen the time within which he may use his rating.

ELECTRIC WATER HEATERS FOR CIVILIAN USE

Limited production of electric water heaters for civilian use has been approved by the War Production Board at an annual rate not to exceed 37 percent of total production by the industry during the base period (July 1, 1940, through June 30, 1941).

Production of electric water heaters for civilian use was heretofore prohibited except when found necessary to allow some production for civilians on an appeal

FOUR of the 18 METROPOLITAN SWITCHBOARDS IN THE JAMAICA SEWAGE DISPOSAL PLANT



At the right are listed various types of electrical control equipment designed and furnished by METROPOLITAN for utilities, industrial plants, large mercantile establishments, and public buildings. Your inquiries are invited.

Knife Switchboards
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Laboratory and Test Switchboards
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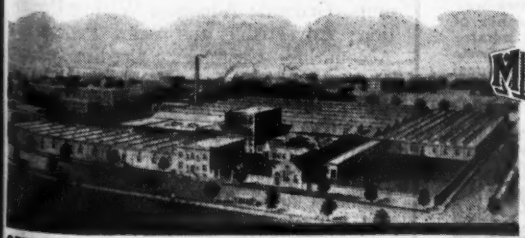

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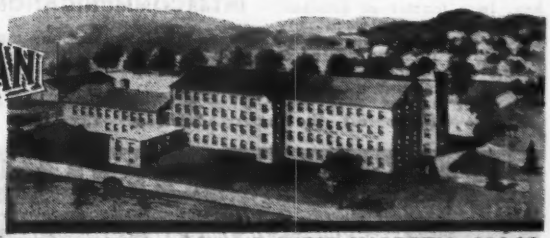
TRADE MARK
ELECTRIC LIGHTING AND POWER DISTRIBUTION EQUIPMENT



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ELECTRICITY
For Any Job—Anywhere

For a dependable source of electricity on projects remote from commercial power, Onan Electric Plants are proven leaders in the field. More than half of the Armed Forces' total requirements for Power Plants are built by Onan.

Gasoline driven . . . single-unit, compact design . . . Sturdy construction . . . Suitable for mobile, stationary or emergency service.

Over 85 models, ranging in sizes from 350 to 35,000 watts, 50 to 800 cycles, 115 to 660 volts, A.C. — 6 to 4000 volts, D.C. — Also dual A.C.-D.C. output types.

Descriptive literature sent promptly on request.

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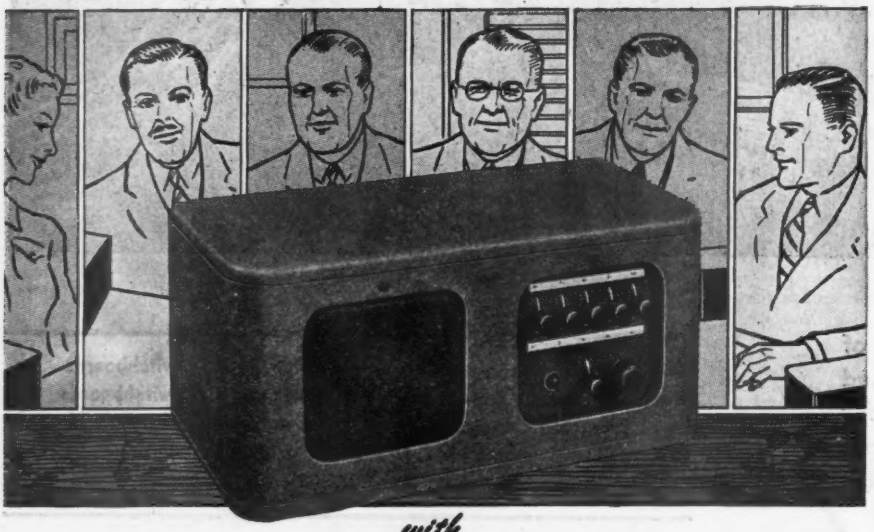
Bring every department within speaking range



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BELL SOUND SYSTEMS

JAMES CLUNE, electrical contractor of Chinook, Montana, is secretary-treasurer of the Montana chapter, International Assn. of Electrical Inspectors. He is with John Crawford, city electrical inspector of Butte, who just finished a successful year as chairman of the chapter with the annual meeting.

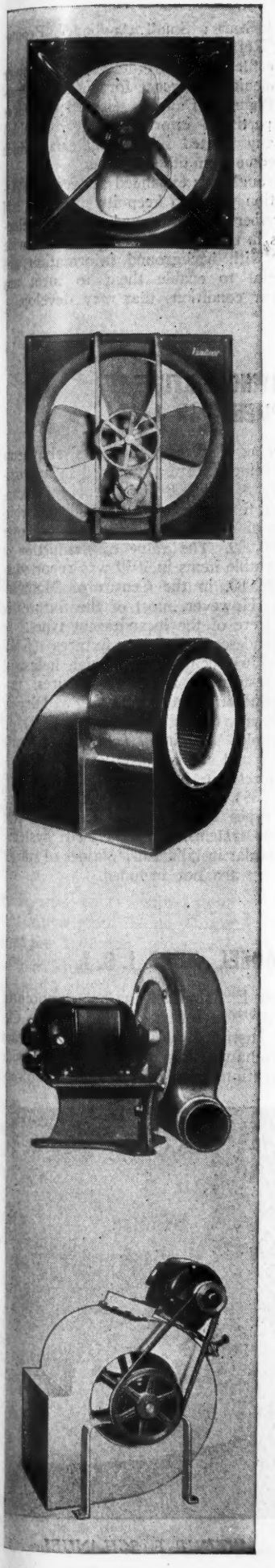
basis. Establishment of a regular quota for production will eliminate the necessity of appeals.

According to the revised L-185, WPB will authorize limited production of electric water heaters on Form GA-1850 for each manufacturer so that aggregate production for each calendar year will not exceed 37 percent of the base year production of the industry as a whole. Production will not be authorized in any plant, however, where such production or labor requirement will interfere with war production in that plant or in any other plant located in that area. Production will be limited to three sizes, based on water storage capacity, and only one model in each size will be allowed. However, a change in the number or design of heating elements will not be considered a change in size or model.

N. C. E. I. FURNISHES POSTWAR SERVICE TO MEMBERS

Coming to the fore with another "first" in the annals of trade association services, the North Central Electrical Industries, Minneapolis, recently began issuing Postwar Planning Bulletins to its membership. Following as a natural sequel to the well established and highly valuable War Regulation Bulletin Service, this supplemental service is designed to provide assistance to industry members during the transition from all-out war production to controlled reconversion.

With the cooperation of the Minnesota Electrical Council, a set of 18 File Folders are being issued with individual imprinted subject titles including: Postwar Planning—General; Adequate Wiring Promotion; Advertising and Sales Promotion; Accounting—Customer Credit; Better Light—Residential; Commercial-Industrial Lighting; Commercial Electric Cooking; Electronic Applications; Electrical Contracting; Modern Electric Kitchens; Home Laundry Equipment; Electric Home Planning; Rural Electrification; Sales Training and Management; Service Equipment—Tools; Store Location



There ought to be a Hall of Fame for Ventilating Contractors

A rush order to remove explosive gases from a powder plant.

A hurry-up call to exhaust dust-laden air from a magnesium foundry.

A pressure blower to supply air for process work.

Equipment to furnish fresh filtered air in plants producing rubber, petroleum, steel, glass, plastics, aircraft and Radar.

These are the vital tasks of America's Ventilating Contractors and Dealers today. Their efforts help to get top production.

As one maker of much needed war goods put it, "The services of one of your contractors made it possible for us to deliver the goods on time. There ought to be a hall of fame for Ventilating Contractors like him."

Tomorrow, after Victory, the leading Ventilating Contractors and Dealers in America will again fill all your wants in air handling with time-proved American Blower Ventilating Equipment. They will make it possible for all to have good ventilation at the minimum of cost.

Then, as always, good ventilation will be good business.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

A REPORT OF PROGRESS

SYNTHETIC RUBBER

INSULATIONS AND SHEATHS
ON SIMPLEX WIRES AND CABLES

During the past few months a new synthetic rubber compound has been developed to replace each special purpose, natural rubber insulation and sheath that has been used on Simplex wires and cables. The results seem miraculous but they are not the result of wishful thinking or crystal gazing. They are solid facts, based on knowledge and skill accumulated during the past sixty years, which make it possible for us to make the most of new insulating materials and do it quickly.

If you use insulated wires and cables for any purpose you will be interested in what we have accomplished with the synthetic rubber insulations and sheaths that are now being used on all Simplex wires and cables. The story is told in an up-to-date booklet entitled "A Report to Industry on Simplex Synthetic Rubber Insulations." It is now being printed and we would like to send a copy to you as soon as it is ready for distribution. A request by postcard or letter to the Simplex representative nearest you or direct to us at Cambridge will have prompt attention.

Simplex WIRES and CABLES

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

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PROMPT SHIPMENT FROM LARGE STOCKS

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and Layouts; Small Appliance Promotion; Refrigeration—Freezers.

The file folders are designed to provide a convenient reference for N.C.E.I. Postwar Planning Bulletins (issued whenever any pertinent information is available) and any related subject material which may come from other sources.

Through this expanded service, the Association plans to keep its members and subscribers well informed on the developments in the postwar field and to provide them with background information and material to enable them to meet any postwar conditions that may develop.

LIGHTING FIXTURE SHIPMENTS IN 1943

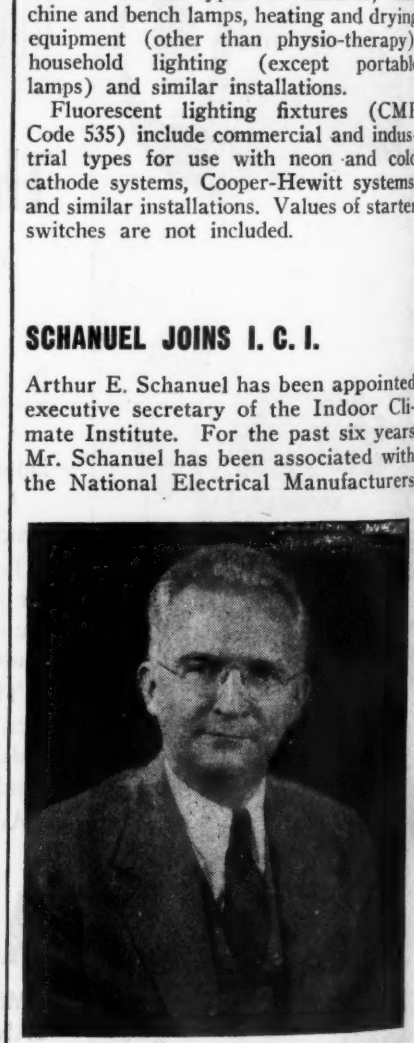
During 1943, manufacturers' shipments of lighting fixtures amounted to approximately $35,200,000; shipments of incandescent fixtures exceeded $15,000,000 while those of fluorescent fixtures were over $20,000,000. The value of production of comparable items in 1939 was reported as $35,328,000, in the Census of Manufactures. However, most of the fixtures in 1939 were of the incandescent types.

Incandescent lighting fixtures (CMP Code 536) include commercial, industrial and residential types of fixtures, machine and bench lamps, heating and drying equipment (other than physio-therapy), household lighting (except portable lamps) and similar installations.

Fluorescent lighting fixtures (CMP Code 535) include commercial and industrial types for use with neon and cold cathode systems, Cooper-Hewitt systems, and similar installations. Values of starter switches are not included.

SCHANUEL JOINS I. C. I.

Arthur E. Schanuel has been appointed executive secretary of the Indoor Climate Institute. For the past six years Mr. Schanuel has been associated with the National Electrical Manufacturers



ARTHUR E. SCHANUEL

Just in case you've eased up... ON YOUR PAY ROLL PLAN

Pause one brief moment. Compare your lot—and that of the men and women in your employ—with the lot of the infantrymen who meet the enemy face to face, who do the hardest fighting, who suffer the most casualties.

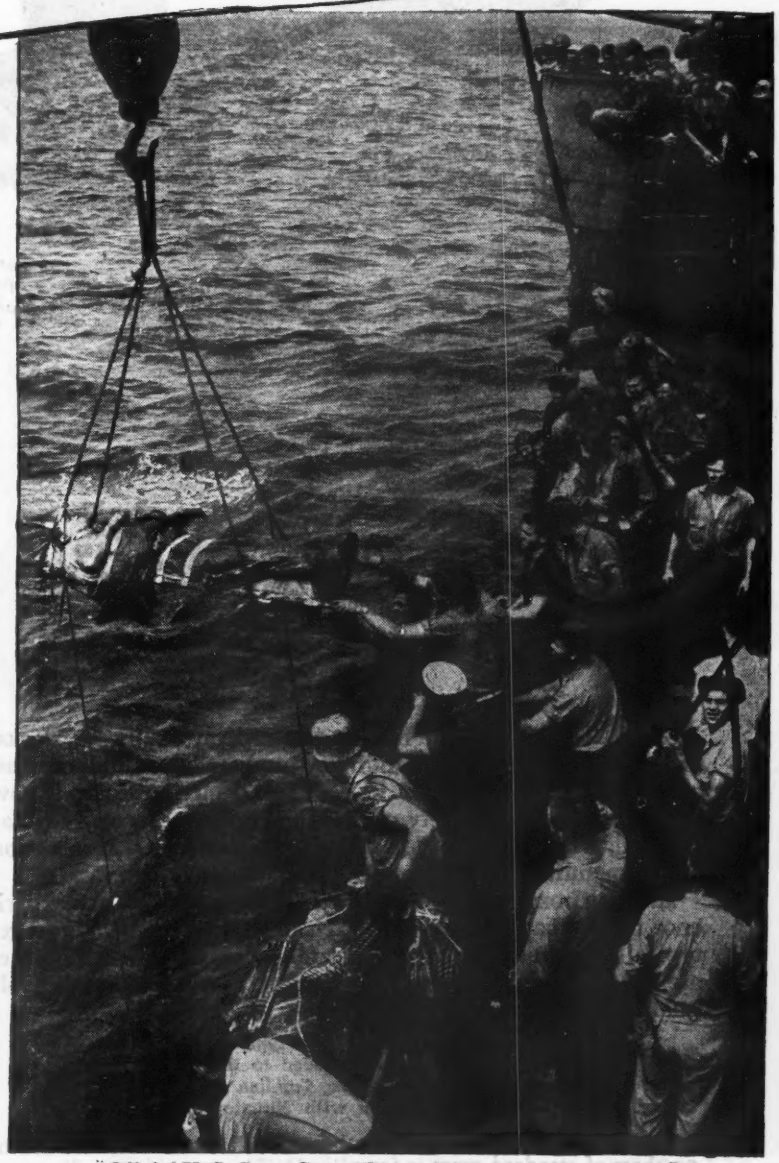
Let the full impact of war's unending grimness swiftly convert any tendency toward complacency into revitalized urgency. Remember—the war is not yet won.

As top management and labor, you've been entrusted with two major responsibilities—steadily maintained production, and steadily maintained War Bond Sales *through your Pay Roll Savings Plan.*

Decide *now* to revitalize your plant's Pay Roll Plan. Have your Bond Committee recheck all employee lists for percentages of participation and individual deductions. Have Team Captains personally contact each old *and new* employee. Raise all percentage figures wherever possible.

Don't underestimate the importance of this task. This marginal group represents *a potential sales increase of 25% to 30% on all Pay Roll Plans!*

Your success will be twofold: A new high in War Bond Sales; and a new high in production. Because a worker with a systematic savings plan has his mind on his work—not on post-war financial worries. He's taking care of the future now. His own. And his Country's future. *Help him!* REVITALIZE YOUR WAR BOND PAY ROLL SAVINGS PLAN.



Official U. S. Coast Guard Photo: The elevator to a Coast Guard-operated transport hospital

Back the Attack!

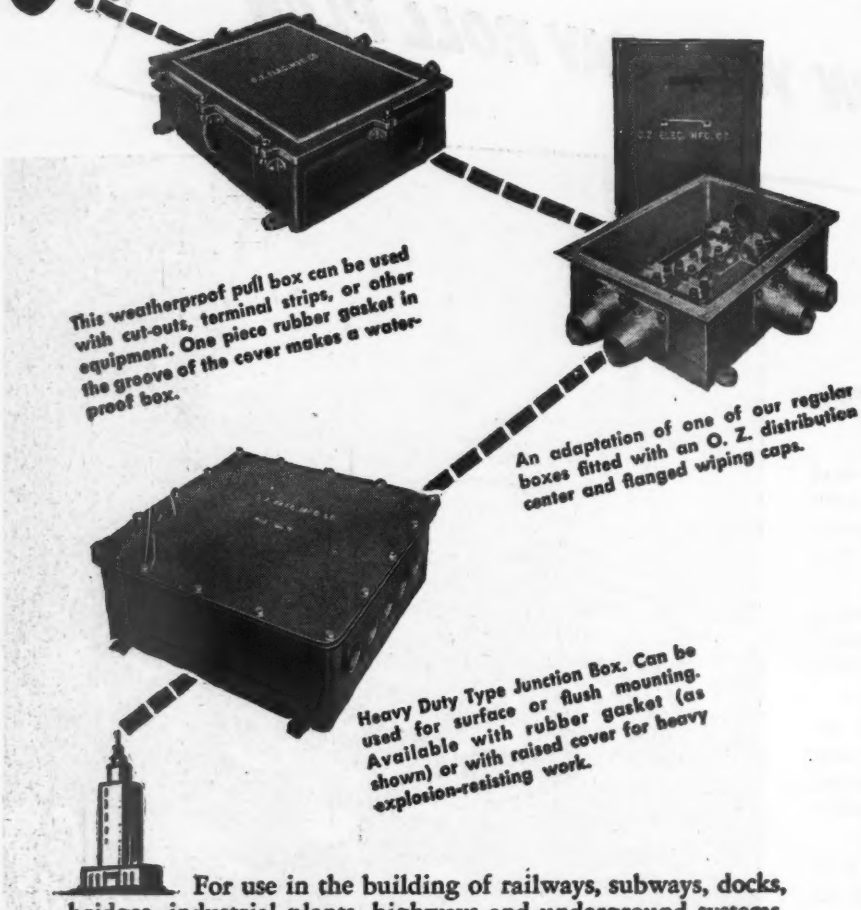
SELL MORE THAN BEFORE!

The Treasury Department acknowledges with appreciation the publication of this message by

ELECTRICAL CONTRACTING

This is an official U. S. Treasury advertisement—prepared under the auspices of Treasury Department and War Advertising Council.

O.Z. NOW OFFERS A COMPLETE LINE OF CAST IRON JUNCTION BOXES



This weatherproof pull box can be used with cut-outs, terminal strips, or other equipment. One piece rubber gasket in the groove of the cover makes a water-proof box.

An adaptation of one of our regular boxes fitted with an O. Z. distribution center and flanged wiping caps.

Heavy Duty Type Junction Box. Can be used for surface or flush mounting. Available with rubber gasket (as shown) or with raised cover for heavy explosion-resisting work.

For use in the building of railways, subways, docks, bridges, industrial plants, highways and underground systems, a completely new line of O. Z. Cast Iron Junction Boxes is now available. Its wide variety of standard units meets any regular demand, while unusual demands can be met by O. Z. Junction Boxes manufactured to your specifications.

In these boxes, you benefit by O. Z.'s quarter-century experience in the manufacture of electrical fittings. In them, you get typically O Z. attention to detail and quality standards. All boxes are constructed of close-grain gray iron castings of machinable quality.

This new Flange Type Wiping Cap has been added to the regular O. Z. Wiping Cap line. Adaptable for use with Junction Boxes.

FULL DESCRIPTION of these junction boxes, with dimensions and catalog numbers of standard types is found in O. Z.'s new 144-page illustrated catalog — along with similar information on more than 160 O. Z. fittings including CONDUIT FITTINGS • CABLE TERMINATORS • SOLDERLESS CONNECTORS • POWER CONNECTORS • GROUNDING DEVICES.

Designers and engineers who are planning post-war building or re-conversion can enjoy the purchasing advantage of using O. Z. as a single high-quality source of supply. Write, on your business letterhead for your free copy.

O.Z. ELECTRICAL MFG. CO.

262 BOND STREET BROOKLYN, 2 N. Y.

REPRESENTATIVES IN PRINCIPAL CITIES

Association as field representative of the National Adequate Wiring Bureau. He has a wide acquaintanceship in the residential branch of the electrical industry and the home building field.

"With the appointment of Mr. Schanuel, the I.C.I. rounds out its first year with a complete program of organization and the establishment of policies which should give great scope, of far-reaching value to the Institute's operations," stated Mr. Zimmerman, president of the organization.

The Indoor Climate Institute has moved into new offices in the Penobscot Building, Detroit.

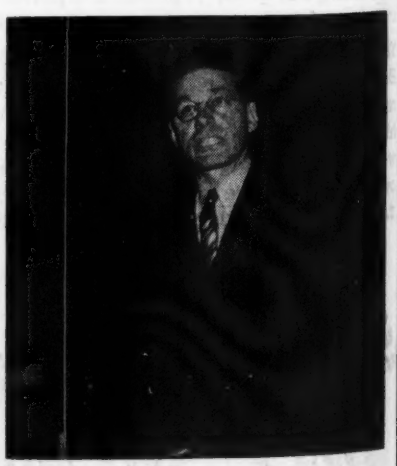
BARTLETT HEADS NAWB PLAN COMMITTEE

J. S. Bartlett, managing director, The Electric Institute of Washington, D. C., has been appointed chairman of the Plan Committee of the National Adequate Wiring Bureau, succeeding C. M. Fife, of West Penn Power Co., who found it necessary to resign because of the pressure of additional company duties. The appointment of Mr. Bartlett was made by Herbert Metz, chairman of NAWB's Executive Committee.

At the same time, announcement was made that John A. Morrison, managing director of The Electrical Association of Philadelphia and a league representative on the Plan Committee, has been appointed to the Executive Committee in place of Mr. Bartlett.

LEAGUE CONFERENCE TO MEET IN DETROIT

The Ninth Annual Conference of the International Association of Electrical Leagues will meet in Detroit, September 20 to 22 for a discussion of industry problems and league promotional activities.



WM. A. BENITT, operator of a 200 acre electrified farm, speaks from experience as he drives home the need for continuous electric service, adequate repair service and adequate wiring at recent N.C.E.I. Rural Electrification clinic at St. Paul.

W. A. Ritt, of North Central Electrical Industries, Minneapolis, Minn., will preside. He has appointed J. A. Morrison of Philadelphia, Pa., J. S. Bartlett of Washington, D. C., and Ralph Neumuller of New York, N. Y., to the program committee.

SURPLUS MATERIALS TO BE CENTRALIZED IN OPEN STORAGE SPACE

Unrequired and surplus material from United States Maritime Commission shipyards and termination inventories from plants of contractors having Maritime contracts will be centralized in open storage spaces, the Maritime Commission has announced.

Material will be moved to open storage spaces as soon as declared "unrequired property." Many Maritime Commission shipyards are changing to new-type vessel construction and are reporting considerable quantities of unrequired material originally intended for use in the construction of other type vessels. Arrival of large volume of material for the new-type vessels has created a serious storage problem in some yards, and in a number of instances has interfered with the operation of yards.

LINN APPOINTED MANAGER OF CALIFORNIA CHAPTER, NECA

A. R. Linn has been appointed manager and representative of the Northern California Chapter, National Electrical Contractors Assn., with offices in the Western Mechandise Mart, San Francisco, according to T. L. Rosenberg, Oakland, president of the chapter. Linn has been an industrial relations officer of Joshua Hendy Iron Works, and has had extensive chamber of commerce experience.

WAR PLANT INSPECTORS STUDY INSPECTION LIGHTING

The Chicago Lighting Institute has scored another "first" in its long list of services to war industry in Chicagoland. This time it was an all-inclusive clinic on "Lighting for Inspection" presented solely for the benefit of Air Corps, Navy and Army Ordnance Inspectors in the Chicago area. When the Institute discovered that 90 to 95 percent of the inquiries it received dealt with problems of lighting for inspection purposes, it decided something had to be done about it and immediately contacted the service branches mentioned above.

The net outcome was a series of six three-hour programs held from July 11-14 inclusive with an attendance "by reservation only" definitely restricted to war plant inspectors invited by an Air

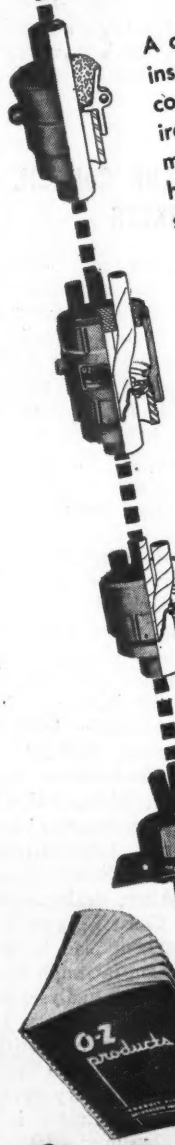
END YOUR TERMINATOR TROUBLES

To meet an insistent demand for a wide variety of Terminators in oil refineries, steel mills, synthetic rubber plants, power plants, sewage disposal plants, chemical and other industries, O. Z. Electrical Manufacturing Company has an individual fitting to meet any problem. O. Z. engineers, for more than 25 years associated with the growth and the development of electrical industries, have designed cable terminators to meet *any* indoor installation.

. . . SPECIFY O. Z.

END FITTINGS
A compact fitting for spacing and insulating wires as they come from conduit ends. Body is of malleable iron, cadmium plated; covers of molded canvas Bakelite having high dielectric and mechanical strength.

INSULATING BUSHING
Using Bakelite as the insulating medium, this bushing is designed to prevent grounds. Casting is made of malleable iron, cadmium plated.



CONDUIT END BELLS
A simple and effective fitting for sealing the end of conduit where lead cable emerges and is exposed. Practical for use indoors or outdoors.

TERMINATING POTHEAD
Substantial units for sealing conduit and cable ends. This fitting has ample space for sealing compound. Use with either lead or rubber covered cables.

COMPOUND BUSHING
Compact sealing units for use where space is limited. Small reservoir is provided for compound.

SEALING BUSHING
Used in cabinets, control boxes, etc. Has no compound chamber and with its reduced height requires a minimum of space.

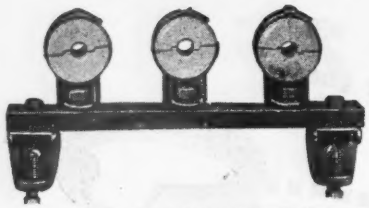
Simplify Your Procurement Problem

To the engineer, contractor or purchasing agent the complete line of electrical fittings manufactured by O. Z. presents a simplification of the supply problem. Here's *one* company that can furnish *any* standard or special fitting—either from stock or made to specifications on short notice.

O. Z. ELECTRICAL MFG. CO.
262 BOND STREET · BROOKLYN, 2 N. Y.
REPRESENTATIVES IN PRINCIPAL CITIES

NEW!

Non-Inductive Conductor Racks



Racks available for any number of cables—cable sizes 5/16" to 2⅝".

● Available in types for any number of cables, the M & W Type S-L Conductor Rack is designed so that cables are only partially surrounded by metal. This prevents induced current—permits the rack to be used for A.C. or D.C. systems. Simple design makes for quick, easy mounting of cables.

Write today for Bulletin C-S-51 . . . contains full information on M & W Non-Inductive Cable and Conductor Racks.

M. & W.
ELECTRIC MFG. CO.
EAST PALESTINE OHIO

A STRONGER FACTOR in TODAY'S NEW
COMPLETE CIRCUIT PROTECTION

EXTRACTOR POSTS
WITH ELECTRICALLY WELDED SIDE TERMINALS

Terminals integral with inner shell mean more strength against extreme shock, vibration and temperatures. Maximum electrical conductivity. New construction for convenience and durability. Shock-proof visual inspection. Specially designed grip prevents fuse from dropping out.

Send for B/P and ENGINEERING DATA
Ask for Samples

342001 finger-operated for 3 A G fuses illustrated. Also furnished screwdriver operated meeting Underwriters' specifications.

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Corps, Navy and Army Ordnance board. A total of 331 "students", primarily chief inspectors, attended the Clinic with an average of 55 per session.

A total of 18 instructors, all members of the Illuminating Engineering Society and affiliated with sponsor firms of the Institute (primarily utility and lighting manufacturers' lighting engineers) were on hand to provide individual instruction at the various stations. On the attendance and equipment procurement committee were three members of the Air Corps; three from the Navy and four from Army Ordnance. An advisory and planning committee of Institute members handled the curricula and plans of the Clinic.

Carl Zersen, manager of the Chicago Lighting Institute, revealed that the same Clinic will be repeated in the fall for additional inspectors of the Air Corps, Navy, Army Ordnance and inspectors for war plant contractors and subcontractors. In answer to inquiries concerning the feasibility of repeating the Clinic in other parts of the country, Mr. Zersen stated that it could be accomplished if interested groups sought the cooperation of the manufacturers, local war plants and local offices of the Air Corps, Navy and Army Ordnance.

NEW JERSEY LEAGUE COUNCIL TO PROMOTE MARKETS

A comprehensive plan for Postwar Market Development and expansion of league activity were the fundamental themes of the New Jersey Council of Electrical Leagues meeting at the Jersey shore resort of Spring Lake. Following President Henry G. Clum's recommendation that the Council hold its quarterly meetings consecutively in the various league districts, the summer quarterly conference was entertained by the Jersey Shore League group.

The main discussion centered around Ronald T. King's report on the work completed to date by the Market Development Committee of which he is chairman. The committee is made up of representatives from various local leagues who represent the five branches of the industry. Mr. King is the utility representative from the Central Jersey League; Richard A. Ruiter, contractor representative from Passaic County League; Richard H. Osgood, manufacturer representative from Essex League; Edgar F. Jobe, distributor representative from South Jersey League; and H. S. Allen, dealer representative from Jersey Coast League.

The Market development plan is comprehensive, but at present, in rough form. It calls for thorough market analyses and a strong promotional campaign. The chairman's report states that competition for the estimated 60 billion dollars saving by the end of 1944 will be very severe, and that if the electrical industry is to get its share of the consumers dollar it must plan, analyze and promote to the extent of its ability.

The actual mechanics of the plan will be in the hands of each local league with recommendations from the Council. That is, working committees in the Council will develop and control the types of surveys to be taken, literature and material to be used for advertising, and the general organization of educational programs. The local leagues will then take these recommendations and materials, develop, perhaps, a few details dictated by local conditions, and then make full use of the facilities by placing bill board and newspaper advertisements where they will do the most good, by organizing educational programs, and by making judicious distribution of all available literature.

The committee expressed the hope that the utilities and manufacturers will help underwrite the program. It is definitely a load-builder and the utilities should find the objectives very favorable. Likewise, it will give added impetus to manufacturer's drives for bigger markets, and thus should merit the manufacturers blessings.

It is also proposed that members should carry part of the financial burden by increasing present obligations, since successful execution of the program will mean increased profits to individual members.

The postwar market has been divided into three general classifications at which specific promotional approaches have been directed. They are, residential, commercial (including institutional and public works) and industrial.

The committee's proposal stated that market analyses will be made from surveys. Residential surveys are to be made by return postcard method. Commercial surveys are to be made by personal canvassing. Industrial surveys are to be made through questionnaires distributed by the Industrial Maintenance Associations which are a large branch of the New Jersey League membership. The entire activity is to be centered about the local leagues.

After a discussion on details by the delegates, each received a copy of the outlined program to present to their local leagues.

INTERPRETATION NO. 1 TO DIRECTIVE 24

The War Production Board has issued Interpretation No. 1 to Directive 24 to make clear the distinction between applications for housing construction handled by the National Housing Agency, WPB, the Department of Agriculture's county war boards and other Government agencies. Directive 24, as amended May 24, gave NHA jurisdiction over certain kinds of housing construction.

The interpretation explains methods of determining where applications should be filed for new construction or alterations on hotels and on buildings containing both residential and commercial space. The kinds of farm housing, institutional housing and housing for transient workers that are not handled by NHA are also pointed out.

The interpretation contains a summary of certain WPB regulations and orders relating to priorities assistance for repairs of housing.

SYDNEY STARGATT (right) former New York City electrical contractor and present chief electrician of an Army Post, being congratulated by Colonel Bernard Lentz, Post Commander. Stargatt was awarded a certificate and $25.00 for a suggestion that has kept waterway beacons burning to guide incoming ships.

COMMITTEE TO STUDY CODE REGULATIONS FOR PREFABRICATED HOUSES

The personnel of the special committee of the Electrial Committee, NFPA, to study and report on wiring methods and other National Electrical Code treatment on prefabricated houses is as follows:

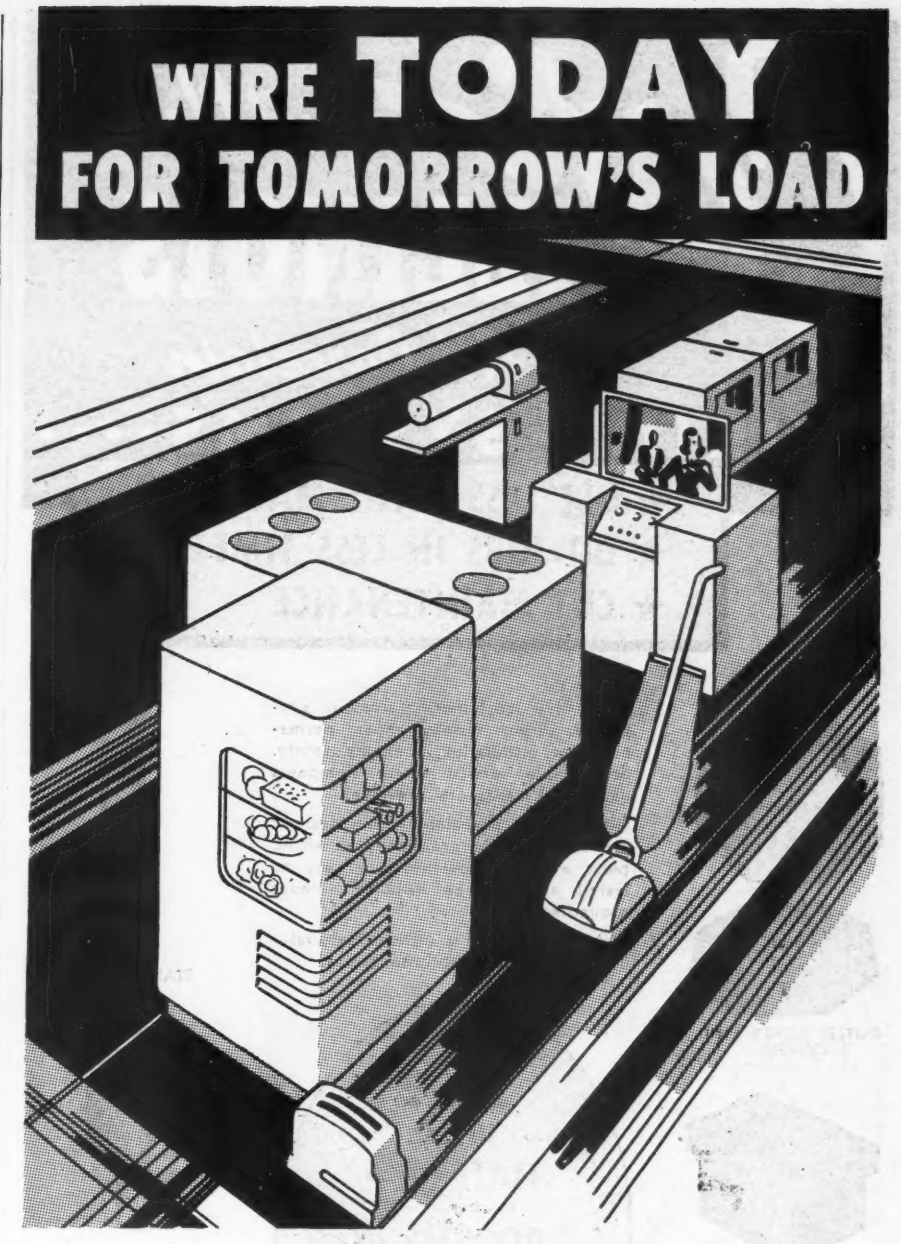
R. L. Lloyd, National Bureau of Standards, Washington, D.C., Chairman; J. H. Arnold, National Board of Fire Underwriters, New York; R. F. Davis, American Telephone & Telegraph Co., New York; C. M. Fife, West Penn Power Co., Pittsburgh, Pa.; C. A. Finkel, The Okonite Co., Passaic, N. J.; H. G. Knoderer, General Electric Co., Bridgeport, Conn.; W. J. Mahan, Electrical Inspector, New Haven, Conn.; W. R. Rilling, Underwriters' Laboratories, Inc., Chicago, Ill.; Harry H. Steidle, Prefabricated Home Manufacturers' Institute, Washington, D. C.; and Howard P. Vermilyea, National Housing Agency, FHA, Washington, D. C.

All suggestions for the Committee's consideration should be addressed to Chairman Lloyd.

MAKE RECOMMENDATIONS ON RURAL ELECTRIC EQUIPMENT

Safety measures on electrical equipment installations dominated the June 6 meeting of the Rural Electric Equipment Council of the North Central Electrical Industries at Minneapolis, Minn. A large representation from all branches of the industry and producers of farm equipment pitched in the discussions and came up with the following recommendations:

Milking Machines—precaution must be taken to insulate pipe line following along stanchions from a possible electrical charge from milking machine motor. Method—install a section of rubber hose over a cut-out vertical section in the



● Tomorrow's big parade of new electrical appliances will mean greatly stepped-up loads for wiring! If it's PORCELAIN PROTECTED — knob and tube wiring—it will carry a BIGGER load in accordance with conductor capacities established by the N.E.C. Experience of half-a-century proves this method does a far better job from the standpoint of simple installation, low cost, safety, long life and dependability. Meets all requirements of directives calling for non-metallic wiring and non-metallic wiring materials. Talk to your Electrical Inspector about wiring trends and safety—he knows fire prevention facts from A to Z. Write for wiring manual.

PORCELAIN PRODUCTS, Inc.
FINDLAY, OHIO
Wire Today for Tomorrow's Load

Save with ILLINOIS All Porcelain WIRING SYSTEMS....

★ USE LESS VITAL MATERIALS
★ DO JOBS IN LESS TIME
★ CUT MAINTENANCE

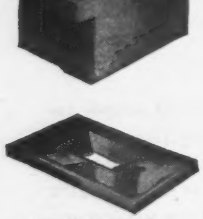
For the customer, porcelain protected wiring systems mean permanency of installation, economy, safety, dependable service where dampness and fire hazards are prevalent.

Illinois all porcelain wiring systems are adaptable to practically all wiring plans and layouts—they are easy to install and can be installed without grounding.

Porcelain is not a critical material—use it for your next installations.

OUTLET BOXES AND COVERS

SWITCH BOXES AND COVERS



TOGGLE SWITCH PLATE

★ SAVES VITAL MATERIALS
DO JOBS IN LESS TIME
CUT MAINTENANCE ★

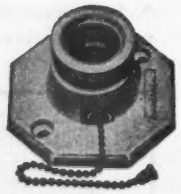
Bull Dog

Look for this Trade Mark

STANDARD TUBES

STANDARD KNOBS

CLEATS



LAMP HOLDERS

ILLINOIS ELECTRIC PORCELAIN CO.
MACOMB, ILLINOIS

pipe line; keep hose clean of any foreign matter that may act as a conductor. Milking machine circuit switch should always be connected in the "hot" side of the circuit and never the neutral; circuit should never be formed through a plug and receptacle without *polarization*.

Electric Water Pumps—proper overload protection was stressed as imperative to prevent animal electrocution due to breakdown of electric motor on the pump. Grounding of motor requires special engineering studies since there are objections to grounding motor to circuit neutral and driven grounds do not seem to have a low enough resistance.

Electric Fences—home-made models prove hazardous in certain cases. Dangerous make-shift units are frequently found where farmers insert lamps in a 110-volt circuit and run electric fence from these lamps—such a circuit does not have high enough frequency to shock animal sufficiently to stop it and has no interrupter in circuit to permit person or animal "caught" on the line to free himself. Farmers present admitted extra investment in approved electric fence equipment could be justified.

110-Volt Equipment—Equipment for operation on 110-volts requiring more than 15-ampere circuit fuses is being offered farmer. Concensus of opinion was that farmers *should not purchase* equipment requiring more than 12 amperes or 1650 watts for operation on 110-volts. Larger equipment should be purchased for operation on 220 volts.

Kilowatt-Hour Consumption—statistics collected by the Council indicated upward of 4 to 5 percent of present farm customers use 500 KWH or more per month. Question was raised as to overloading of 60-ampere main switch at meter. Recommendations were made that the farmer call in his wireman to study the load distribution, requirements for additional wiring or larger service switch. Estimates show that 20 percent of all wired farms in Minnesota may be reaching an overloaded condition at main service.

Additional meetings of the Rural Electric Equipment Council are planned to discuss similar and related subjects and to make recommendations to remedy conditions found to be hazardous.

REVISED OPA REGULATION ON BOLTS, NUTS, SCREWS AND RIVETS

A revised price regulation covering bolts, nuts, screws and rivets, which defines more clearly the transactions to which it applies and clarifies its coverage, has been issued by the Office of Price Administration. It takes the place of the original regulation (Maximum Price Regulation No. 147) issued in May, 1942, and two amendments.

The changes cover the clarification of several industry practices not specifically included in the original regulation, and with rewording of various provisions for purposes of simplification. A new provision, dealing with producers' minimum charges on small orders, has been added. Other changes deal with orders for small

quantities of standard items temporarily not in stock and with the relationship of producers' price schedules to maximum prices. The revised regulation became effective July 12, 1944.

The revised regulation requires the producer to charge not in excess of the prices in the price schedules which he used for pricing purposes between October 1 and 15, 1941, the base pricing period, whether or not such price schedules were published.

RATINGS INCREASED WITH SILICONE INSULATION

As much as 50 percent reduction in weight of electric equipment is possible where design limitations are based on insulating temperature by using the new Silicone insulating varnishes. These high temperature insulations also make possible a substantial increase in the output of small motors using the same frame, where the operating temperature can be raised. They offer the additional advantages of ability to operate at higher ambient temperature, and to greatly increase life when operated at present temperature conditions. Silicone resins, and their use as insulating varnishes and bonds, definitely fill the void between organic and inorganic insulating materials.

There has long been a demand for high temperature insulation having better thermal stability. Designers have felt the need for such insulation for three reasons.

1. It offers possibilities for reduction in the size and weight of electrical equipment, with no reduction in service life, where the operating temperature can be increased because of this improved thermal endurance.
2. Greatly increased service life in the same size and weight where it is necessary or desirable to maintain present temperature limits.
3. Increased ambient temperatures which reduce limitations as to operating locations.

Over two years experience on actual equipment confirms extensive laboratory tests which showed these materials to be promising. For example: To meet a very special requirement, a 3 hp. totally enclosed induction motor was redesigned for 10 hp. with no increase in weight or size. Since then, more than 30 similar motors using high temperature insulation have been built and are now being tested under various conditions. A mine locomotive motor armature has been functioning perfectly under very adverse conditions for over a year since being rewound and high-temperature insulated. Prior to this, insulation failures occurred frequently, a few less than a month apart. Street car and trolley coach motors with Silicone insulation have been given exhaustive tests at elevated temperatures. Results show increased horsepower output at no increase in speed with no injury to insulation.

A 250 kva. generator with high temperature insulation was operated in the laboratory for about 3000 hours at 250°C. with no ill effects to the insulation. According

KLEIN QUALITY

This book on the care and safe use of tools will be sent on request.

THREE-QUARTERS of a century ago, pioneers who strung the first electric lines recognized that the tools then available were not good enough for the exacting service their work demanded. They came to the little forge shop of Mathias Klein with requests for specially made tools, high in quality—better able to stand punishing service. The small forge shop has grown into a large plant—specifications have changed to meet the new demands of a field that is noted for its improved technology—but the ideal of high quality that Mathias Klein built into his first pair of hand forged pliers is the ideal that is still back of all tools and equipment carrying the name Klein. Today, Klein tools and equipment remain the first choice of linemen—electricians—good workers everywhere.

ASK YOUR SUPPLIER

Foreign Distributor: International Standard Electric Corp., New York

Mathias KLEIN & Sons
Established 1857 — Chicago, Ill., U.S.A.
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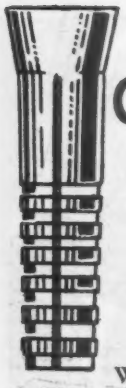
Since 1857



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LEAD WOOD-SCREW SHIELD for Quick Anchorage!

Dependable CHICAGO Lead Wood-Screw Shields offer the practical solution for quick anchorage with ordinary wood screws in concrete, brick, masonry, plaster board or plaster walls. Made of high grade lead, these shields are so designed that the wood screw cuts its own thread as it expands the shield. The exterior ribs of the shield grip the sides of the hole and provide positive anchorage. No special tools are required to set these anchoring devices. Furnished in various sizes from No. 5 screw up to ¼".

IMMEDIATE DELIVERIES

on these and other dependable CHICAGO anchoring devices. Write for new catalog or call your wholesaler.

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CHICAGO EXPANSION BOLT COMPANY

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MINERALLAC

New Practical Unit to Cut Installation Time

• The "Messenger Hanger" and the "Messenger Strap" fill the need for an economical, practical, time-saving unit for use with the new messenger cable type of installation. Mechanically strong, durable, lightweight. They save considerable materials and are easily and quickly installed. Our bulletin gives full and complete details—send for it.

See your Jobber.

"Messenger Hanger" for Conduit and Cable Strong made of Cadmium Plated Steel or Everdur. Top loop of hanger grips messenger cable to permit conduit to be put in place without falling off.

"Messenger Strap" for Outlet Boxes Of Cadmium Plated Steel or Everdur. For messenger cable installation to be used with Mineralac "Messenger Hanger." Fits all standard outlet boxes and ⅜" messenger cable.

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to the best available means for interpreting accelerated life tests, this is equal to far more than normal life expectancy.

Where temperature, or size and weight as determined by temperature, are important factors in electrical equipment design, the problem should be examined in the light of these recently developed insulating materials. Silicone insulations should not be considered a panacea for all insulating ills, but instead, should be applied to specific applications where its use is justified.

This new insulating material was developed by scientists of the Corning Glass Company working in conjunction with Dow Chemical Company engineers. The Dow Corning Corporation of Midland, Michigan has been formed for large scale production. Performance data of Silicones used as electrical insulation has been obtained through tests made in conjunction with Westinghouse engineers.

McCRAY ELECTED PRESIDENT OF E. M. E. A.

Robert McCray, maintenance engineer, University of Pennsylvania, was elected president of the Electrical Maintenance Engineers Association of Philadelphia for the 1944-45 season.

Homer S. Kepner, electrical maintenance engineer, Gulf Oil Corporation, was elected vice president. The following were elected to serve on the Executive Committee for a three-year term; Alfred C. Lemper, Philadelphia Navy Yard; Frank B. Moxley, Jr., C. Schmidt & Sons, Inc.; Frank J. Roth, Philadelphia Dairy Products Company, and George Stocker, Edw. G. Budd Manufacturing Company.

WEBER RETIRES AS ENGINEER

Fred D. Weber, electrical engineer for the Oregon Insurance Rating Bureau of Portland, Oregon, and secretary-treasurer of the Northwestern Section, IAEI since its organization in 1926, has resigned both positions to retire to a new home in Pasadena, California.

After graduation from the University of California with a B.S. degree in Electrical Engineering in 1904, Mr. Weber embarked on a career in the electrical field which won him official appointments in the various technical societies. He was chief electrical engineer for the Oregon Insurance Rating Bureau of Portland since 1909—the position he recently vacated. During his full career, he has been a member of the Electrical Council of the Underwriters' Laboratories, Inc., the Board of Electrical Examiners of Oregon; president of the State Board of Engineering Examiners of Oregon; president of IAEI in 1932; member of the Electrical Committee, NFPA, representing the Northwestern Section, IAEI; president of the Electric Club of Portland; and secretary-treasurer and life member of the Professional Engineers of Oregon. He was active on technical subcommittees of the NFPA; in the formulation of a state building code; and chairman of the Electrical Workers Sub-Commission of the Oregon Building Congress for furtherance of apprenticeship training.

The office he left vacant in the Northwestern Section, IAEI, has been filled by the appointment of E. B. Morrison as secretary pro tem. Mr. Morrison, assistant electrical engineer of the Oregon Insurance Rating Bureau, was president of the Northwestern Section, IAEI in 1939 and has served on a number of its committees in the past.

LOWRY JOINS NECA FIELD STAFF

The field staff of the National Electrical Contractors Association was recently completed with the appointment of P. J. "Pat" Lowry of Cleveland, Ohio, as representative for Division 2 (Pennsylvania, Delaware, Maryland, District of Columbia, Ohio, Kentucky and West Virginia).

"Pat" who began his NECA activities July 17 with headquarters in Pittsburgh, Pa., was a conduit salesman for the Cleveland office of the Youngstown Sheet and Tube Company for the past eight years. Prior to that he occupied the office of City Electrical Inspector at Youngstown, Ohio, for a period of six years. It was at Youngstown that he learned the electrical game as a journeyman electrician.

SMALL ELECTED HONORARY MEMBER, NFPA

Alvah Small, president of Underwriters' Laboratories, Inc., was elected to honorary membership in the National Fire Protection Association at the recent annual meeting of that organization in Philadelphia. The honorary life membership roster contains only sixteen names—eleven of which are deceased. Mr. Small was president of NFPA from 1940 to 1942.

George W. Elliot, chairman of the Board of Directors, NFPA, stressed the 50th Anniversary of Underwriters' Laboratories, Inc., in his presentation address.

LIGHTING WITHIN INDUSTRY IS SUBJECT OF NEMA BROADSIDES

A series of three mailing broadsides covering manpower, production and maintenance has just been issued by the Direct Mail Promotional Committee of the Industrial and Commercial Lighting Equipment Section of NEMA.

Designed to stimulate lighting within industry, the broadsides are being offered to utility companies and electrical leagues

on a non-profit basis for mailing to industrial lighting prospects. They are profusely illustrated and attractively printed in two brilliant colors. They come complete with imprinted return cards for mailing at the third class postage rate.

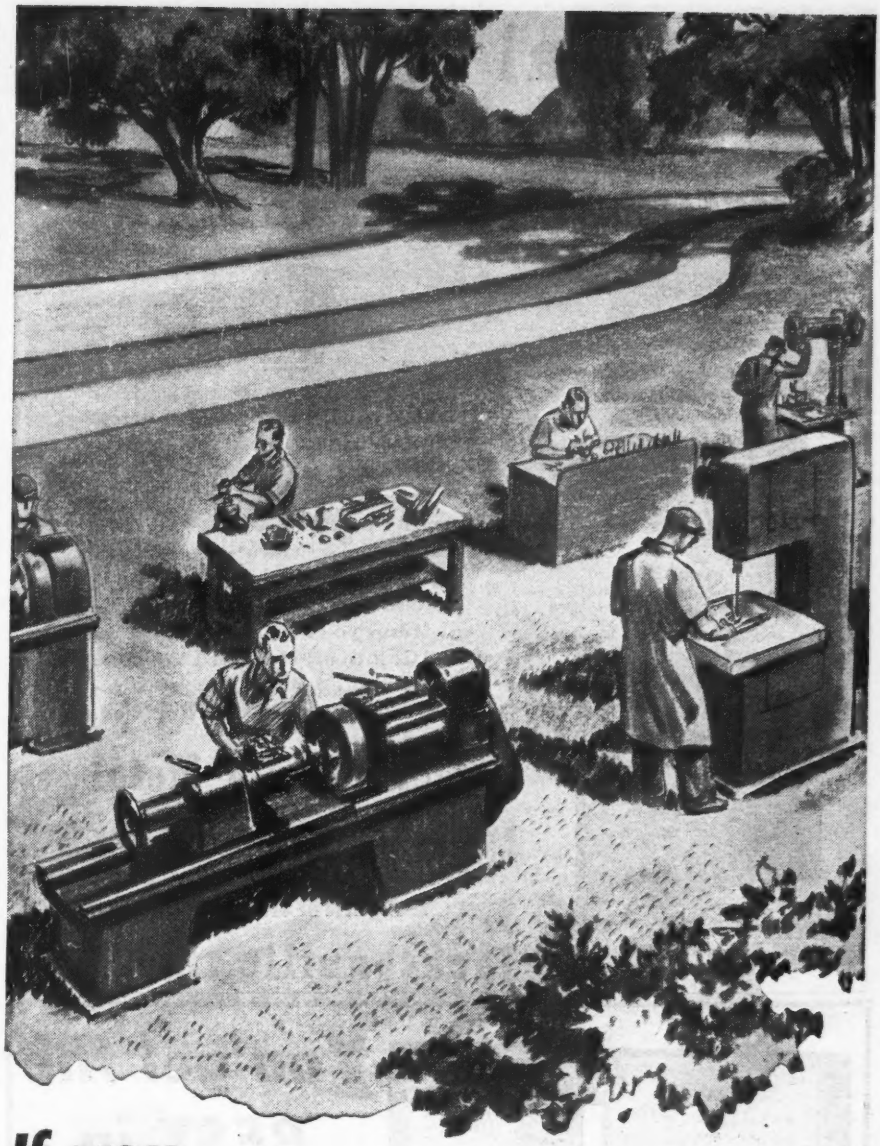
This group of mailing pieces constitutes the first step by the NEMA Industrial and Commercial Lighting Equipment Section in its program designed to render the broadest possible service to the lighting industry.

KIELEY HEADS NORTH DAKOTA CONTRACTORS

Clyde Kieley, Grafton, N. D., was elected president of the North Dakota Electrical Contractors Association at a recent meeting of that group. Other officers elected for the 1944 term include: Carl Wild, Milton—vice-president; and Ray Hintgen, Wahpeton—secretary-treasurer. The following Directors were chosen: Fred Miller, Dickinson; Dewey Rasche, Bottineau; B. K. Skeels, Bismark; and Charles Wood, Fargo.

DATES AHEAD

Rocky Mountain Chapter IAEI—Monthly meeting, Denver, Colo., August 8.
George Washington Chapter IAEI — Monthly meeting, District Building, Washington, D. C., August 14.
Roger William Chapter IAEI—Monthly meeting, Providence, R. I., August 16.
Long Island Chapter, IAEI—Long Island Lighting Company Auditorium, August 18.
Cook County Electrical Contractors Association—Monthly meeting, Electric Association Dining Room, 20 N. Wacker Drive, Chicago, August 21.
International Association of Electrical Inspectors — Northwestern Section, Olympian Hotel, Olympia, Wash., August 21-23; Southwestern Section, Hotel Palomar, Santa Cruz, Calif., August 28-30; Western Section, Claypool Hotel, Indianapolis, Ind., September 11-13; Eastern Section, DeWitt Clinton Hotel, Albany, N. Y., September 18-20; Southern Section, Ausley Hotel, Atlanta, Ga., September 25-27.
American Institute of Electrical Engineers—Pacific Coast Technical Meeting, Biltmore Hotel, Los Angeles, Calif., August 29-September 1.
Utah Chapter IAEI—Monthly meeting, Salt Lake City, Utah, September 5.
American Institute of Consulting Engineers—Luncheon and Council meeting, City Midday Club, New York City, September 6.
New York Electrical Contractors Association—Regular Meeting, 2 Park Avenue, New York City, September 6.
Empire City Chapter, IAEI—Elmira, N. Y., Sept. 8.
George Washington Chapter IAEI — Monthly meeting, District Building, Washington, D. C., September 11.
Central District Chapter NISA—Monthly meeting, Electric Association Dining Room, 20 N. Wacker Drive, Chicago, September 12.
Rocky Mountain Chapter IAEI—Monthly meeting, Denver, Colo., September 12.
Illuminating Engineering Society—Annual conference, Edgewater Beach Hotel, Chicago, Ill., September 14-16.
Roger William Chapter IAEI—Monthly meeting, Providence, R. I., September 20.
International Association of Electrical Leagues—Ninth Annual conference, Detroit, Mich., September 20-22.
American Standards Association—Standards Council, New York, N. Y., September 21.
Indoor Climate Institute—A two-day Open Forum, Book-Cadillac Hotel, Detroit, Mich., September 21-22.



If you could work this way . . .

SOFT breezes, pleasant scenery and nature's finest illumination . . . what more could a workman ask?

We can't provide the scenery or the sunshine, but Goodrich *can* and *does* make the closest possible approach to nature's own standards of illumination. What's more, Goodrich lighting is constant—day after day. It's controlled illumination . . . minimizing shadows, sharp contrasts and glare.

By controlling these hazards, by affording *ample lighting* with *uniform distribution,* Goodrich is helping to set a faster pace in all types of plants . . . for comfortable vision is a work stimulant.

If it's reduced worker fatigue, fewer errors, faster production you seek, *remember:* Goodrich lights the way!

Sold through electrical wholesalers

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ELECTRIC COMPANY
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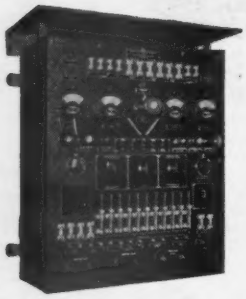
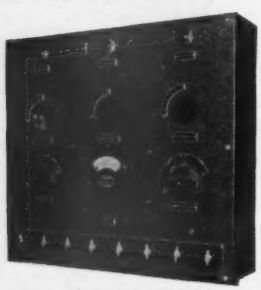
Electrical Specialties
of Every Type
Including MARINE WORK



WORK TEST PANEL—built to customers' specifications and Navy standards.



RADIO MOTOR-GENERATOR and SELECTOR CONTROL PANEL—built to customers' specifications for any number of circuits.

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ALL types of electrical specialties, boxes, cabinets, control panels, duct-work, etc., manufactured by an organization accustomed to meeting exacting Army, Navy and Commercial specifications. Full engineering personnel and equipment for manufacture of special electrical items to customers' needs in addition to all standard articles. Let us quote you on your requirements. Write for illustrated catalog.

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You get the BEST in Time Switch Experience WITH BADGER

• This BADGER Synchronous Automatic Time Switch is specifically a heavy duty model with a capacity great enough to meet a wide variety of requirements. There is constant demand for these sturdily constructed time switches with more than thirty years of proven dependability to recommend them.

They are completely automatic and are furnished in single and double pole construction with indoor and outdoor cases.

You can guarantee accurate timing, economical operation, and years of dependable service for your customers. See your Wholesaler or send for catalog.

• *Prompt delivery on orders rated AA-5 or Higher.*

Type	Poles	Switch Capacity	Case
M1 (Synchronous)	1	50 A. at 125 V.,	16 Ga. Steel
M2 "	2	50 A. at 125/250 V.	16 Ga. Steel
RM "	1	50 A. at 125 V.	Cast Iron
RM5 "	2	50 A. at 125/250 V.	Cast Iron

RELIANCE AUTOMATIC LIGHTING CO. RACINE WISCONSIN

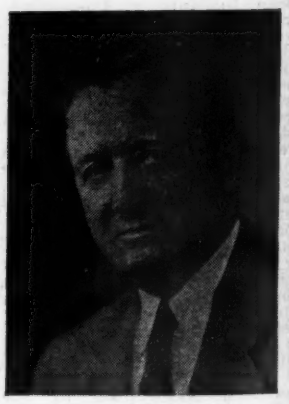
Electrical Credit Association, Chicago Chapter—Annual meeting, September 21.
National Electrical Contractors Association—Annual meeting, French Lick Springs Hotel, French Lick, Indiana, Oct. 1-5.
International Municipal Signal Assn.—Annual meeting, Hotel Statler, Boston, Mass., Oct. 2-4.
Utah Chapter IAEI—Monthly meeting, Salt Lake City, Utah, October 3.
American Institute of Consulting Engineers—Luncheon and Council meeting, City Midday Club, New York, N. Y., October 4.
American Gas Association—Annual meeting, Chicago, Ill., October 5.
National Electronic Conference—Medina Club, Chicago, Ill., Oct. 5-7.
National Safety Congress of National Safety Council—Sherman, Morrison and La Salle Hotels, Chicago, Ill., October 3-5.
Eastern New England Chapter, IAEI—United Shoe Machinery Building, Boston, Mass., October 18.
Electronic Parts and Equipment Industry Conference—Stevens Hotel, Chicago, October 19–21.
National Electrical Manufacturers Association—Annual meeting, Waldorf-Astoria Hotel, New York, N. Y., October 23-27.
Electrical & Gas Association of N. Y., Inc.—Thanksgiving Luncheon, Grand Ballroom, Hotel Astor, New York, N. Y., November 22.
Electrical & Gas Association of N. Y., Inc.—Christmas Luncheon, Grand Ballroom, Hotel Astor, New York, N. Y., December 20.
National Electrical Manufacturers Association — Spring Conference, Palmer House, Chicago, April 16–19, 1945.
International Lighting Exposition — Palmer House, Chicago, Ill., April 19-23, 1945.
National Electrical Wholesalers Association—Spring meeting, April 23–25, 1945.

MANUFACTURERS NEWS

ESSEX WIRE CHANGES

The following additions to the executive sales staff of The Essex Wire Corporation and The Paranite Wire and Cable Corporation of Fort Wayne, Ind., have been announced by W. J. Shea, vice president and director of sales.

H. E. Eagleston, vice president and general sales manager, directs the sales activities of the three wire divisions



H. E. EAGLESTON

which are located at Detroit, Fort Wayne and Jonesboro, Ind.

P. E. Stouffer, assistant sales man-

ager, is responsible for magnet wire sales in the central and western territories.

J. J. Madden, assistant sales manager, is responsible for the Paranite sales in the eastern territory.

W. A. Ward, office sales manager of both the Essex and Paranite Divisions, is responsible for the inside sales department at the Fort Wayne, Ind. office.

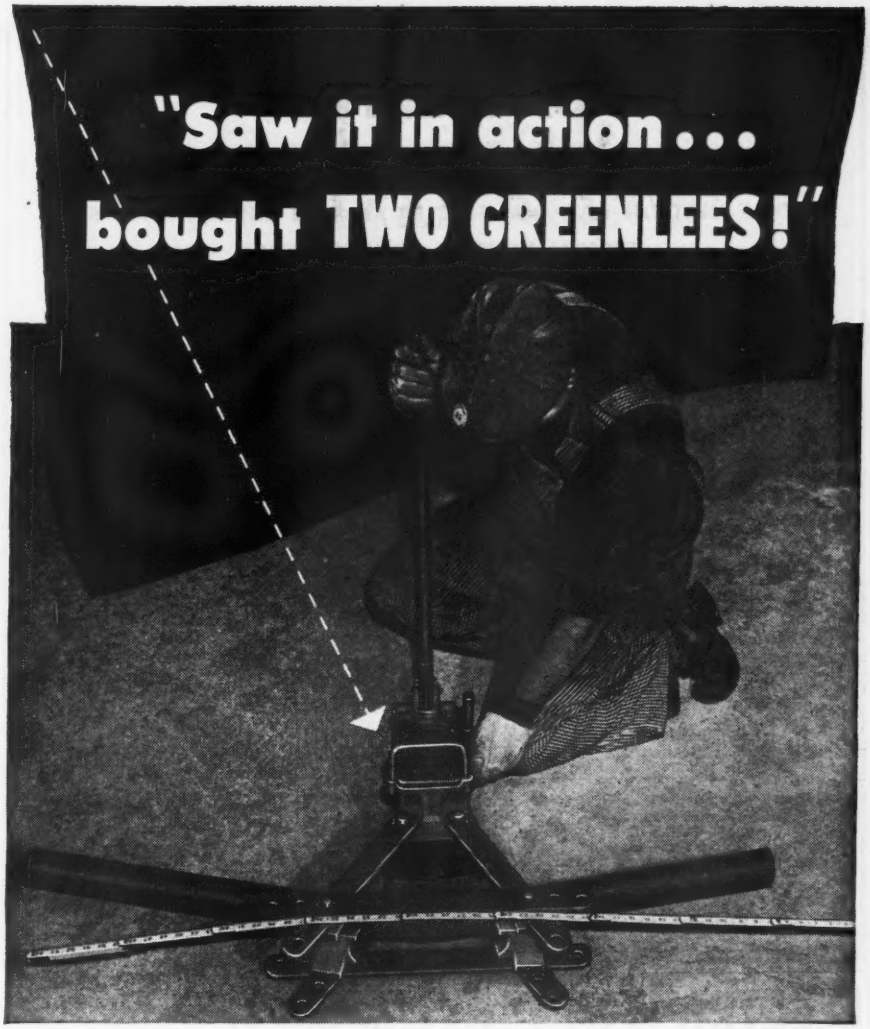
WESTINGHOUSE APPOINTMENTS

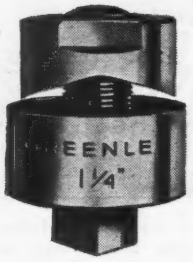
L. E. Osborne, vice president and manager of the Steam Division of the Westinghouse Electric & Manufacturing Company, Philadelphia, Pa., has announced the appointment of Floyd T. Hague as assistant to the vice president. Mr. Hague will serve as engineering consultant and will act in the same capacity for all departments of the division.

At the same time C. B. Campbell was named manager of engineering, filling the position left vacant by Mr. Hague, and J. S. Newton was appointed assistant manager of engineering.

J. S. Henderson has been appointed coordinator of rural electrification for the Industry Departments of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa. Westinghouse has formed a new department known as the Water Heater and Dishwasher Department and has appointed M. M. Feaman as manager. These appliances previously were assigned to

USE OF CAPACITORS for power factor correction is outlined to Chicago motor shop men by N. M. Mintz, application engineer representing the Cornell-Dubilier Electric Company.





KNOCK-OUT Tools

Eliminate time spent on drilling and filing to enlarge a hole. In 1½ minutes or less you can cut a hole up to 3½" with the GREENLEE Cutter or Punch. Just insert the tool in a knock-out or small drilled hole, give a few turns of the drive nut with an ordinary wrench!

These tools cut clean, round holes in bakelite, hard rubber or any metal up to ⅜" thick.

Other GREENLEE time-saving tools for electrical work:
CABLE PULLERS
JOIST BORERS
HAND BENDERS
RADIO CHASSIS PUNCHES
PIPE PUSHERS

"Over five years ago we saw the GREENLEE Pipe Bender on a job, liked its performance and bought *two* for our own use", says Mr. James A. Hays, Foreman MacKay Electric Co., Kansas City, Mo.

"Large *time and material* savings are made with the GREENLEE especially on any job where great quantities of pipe are being used"... Mr. Hays continues... "and outside of a little hydraulic oil used the maintenance costs total practically nothing!"

Leading contractors throughout the country have been selecting GREENLEES for these same reasons. They can be carried, set up and operated by one man... make smooth, accurate bends where you want them—no kinks or other damage to conduit.

Pipe up to 4½", rigid and thin-wall conduit, tubing, bus bars...*whatever* the bending job... there's a GREENLEE to do it better, faster. Catalog 33E tells whole story on GREENLEE Benders and other special tools for electrical work. It's yours free—just write to Greenlee Tool Co., Division of Greenlee Bros. & Co., 1748 Columbia Ave., Rockford, Ill.

Get Ready with Greenlee!

REGISTERED TOOLS
GREENLEE
FOR THE CRAFTSMAN

A Complete Line of

BAKELITE

OUTLET BOXES *and* COVERS

THAT MEET THE NATIONAL ELECTRICAL CODE AND APPROVED BY

FEDERAL HOUSING ADMINISTRATION

BOXES FURNISHED WITH OR WITHOUT CLAMPS

No. 3050 No. 4050 No. 5050 No. 6050 No. 7050

Nos. 3051 & 4051 Nos. 3052 & 4052 Nos. 3053 & 4053 Nos. 3054 & 4054 No. 4055 Nos. 3057 & 4057 Nos. 3056 & 4056

SAFE • ECONOMICAL • DURABLE • NEAT

The sizes and design, except for clamps and wire knockouts, same as standard metal outlet boxes. They take standard type of fixture studs. Two clamps supplied with each box. The wire clamps hold against 125 lbs. pull. When used with fixture studs they withstand over 400 lbs. pull on stud.

These Bakelite Outlet Boxes have side knockouts and clamps to take 14-2, 14-3, and 12-2 non-metallic sheathed cable, and 14-2, 14-3, 12-2 and 12-3 CNX Type Cable and one ½ in. Bottom Knockout.

These covers are sufficiently thick to obviate breakage in installation or use. Standard color Black.

UNION INSULATING COMPANY, INC.

FACTORY:
PARKERSBURG, W. VA.

SALES OFFICE:
27 PARK PLACE, N. Y. C.

ELECTRICITY for RADIO work

with radio sets
test equipment
electronic devices

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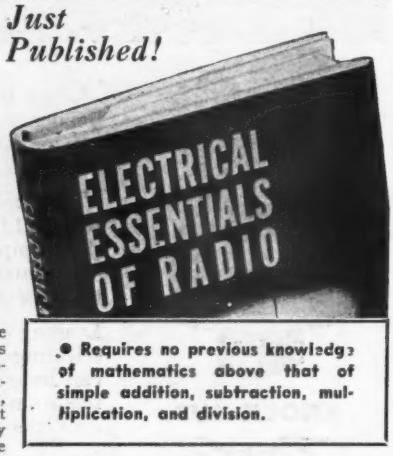

Here, for radio beginners and workers, is a simple introduction to electrical theory and its applications to practical work with any type of radio set, test equipment, or electronic device. The book offers the background of electrical theory required to make an efficient, thoroughly qualified radioman, equipped to carry out repair and manufacturing jobs quickly and successfully and to keep in step with the rapidly advancing science of electronics.

• Requires no previous knowledge of mathematics above that of simple addition, subtraction, multiplication, and division.

Electrical Essentials of Radio

This book fully explains the basic electrical principles of radio according to the electron theory. It gives detailed descriptions of the construction of commercial products based on these principles, with plenty of illustrative diagrams and photographs. It explains the purpose of each part used and how this purpose is accomplished, and the book shows the application of each of the principles in a radio circuit.

Covers basic theory of electricity, batteries, electric circuits, magnetism, types and uses of meters, various kinds of power systems, inductance, capacitance, circuit characteristics with alternating current, resonance, basic radio circuits.

By MORRIS SLURZBERG and WILLIAM OSTERHELD

Instructors of Electricity and Radio, William L. Dickinson High School, and Evening Technical and Industrial High School, Jersey City, N. J.

529 pages, 5½ x 8½, 366 illustrations, $4.00

McGRAW-HILL EXAMINATION COUPON

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Send me Slurzberg and Osterheld's Electrical Essentials of Radio for 10 days' examination on approval. In 10 days I will send $4.00 plus few cents postage or return book postpaid. (Postage paid on cash orders.)

Name .....
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City and State .....
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SYLVANIA PROMOTION

Sylvania Electric Products, Inc. has promoted Curtis A. Haines to the position of general manufacturing manager of the Mill Hall and Altoona, Huntington, W. Va. and Lexington, Ky., plants.

W. Herbert Lamb, formerly manufacturing superintendent at Mill Hall has been promoted to manager of the Huntington plant and John M. Palmer, manufacturing superintendent at Altoona, to the post of manager at both Mill Hall and Altoona. William Toner is in charge at Lexington and Gus Stackelhouse is superintendent of production at Huntington.

ALLIS-CHALMERS APPOINTMENTS

Ernest Mahler, executive vice president of the Kimberly-Clark Corporation, Neenah, Wis., has been elected to the board of directors of the Allis-Chalmers Manufacturing Company. Mr. Mahler takes the place of R. G. Hutchins, New York, who retired after 31 years of service on the board.

B. H. McCoin has been transferred to the Atlanta Office of the Allis-Chalmers Manufacturing Company as a field engineer. He will cover the territory which includes Georgia and parts of Tennessee and North and South Carolina.

LITTELFUSE APPOINTMENTS

R. G. Akin has been appointed sales manager, Midwest Division of Littelfuse Inc., of Chicago. Preceding his connection with Littelfuse he was national sales manager of the Cellulose Tubing Division of Sylvania Industrial Corporation, New York.

Dee Breen has been appointed sales manager of the Western Division of Littelfuse with territory covering the western states and headquarters at the company's plant at El Monte, Calif. Mr. Breen was formerly production manager for Littelfuse's Chicago plant.

GRAYBAR CHANGES

At a recent meeting of the Graybar Electric Company Board of Directors, George J. Cossmann, Graybar Central District Manager in Chicago, was elected a Director of the Company. Also at the same meeting E. W. Shepard, Treasurer of the Company, was appointed a member of the Executive Committee.

John W. Horne was appointed manager of Graybar's Savannah House. He succeeds Harry B. Stanton, who is retiring from the company after 43 years of service. Mr. Horne joined Graybar in 1933, serving first at Miami, later at Savannah and Tampa, and then returned to Savannah in 1942 as combination Supply and Appliance salesman.

COPPERWELD CHANGES

Roy C. Raasch, formerly of the Chicago Office of the Copperweld Steel Company, has been transferred to Cleveland, Ohio, where he will assume charge of that office which is located at 1158 Union Commerce Building. He succeeds E. N. Hazlett who has resigned.

A. B. Leach will take over the assignments previously handled by Mr. Raasch in the Chicago Office. He formerly represented the Copperweld Steel Company in the St. Louis area.

E-M APPOINTMENT

R. H. Olson, who has been manager of the New York district office of Electric Machinery Mfg. Company, has been appointed vice president in charge of sales, with headquarters at the company's home office in Minneapolis.

Mr. Olson began his E-M sales career in 1919, after graduation from the University of Minnesota, at the Minneapolis district office of Electric Machinery. In 1925 he went to St. Louis as district manager, and in 1930 he became district manager at New York.

A. P. Burris will take over the duties of district manager at New York, to fill the vacancy created by Mr. Olson's election to vice presidency.

•

Cutler-Hammer, Inc., of Milwaukee, Wis. has announced the opening of a drive-in warehouse at 1200 Walnut Street, Cincinnati, Ohio. At present Cutler-Hammer maintains a district sales office at Central Parkway and Walnut Street in Cincinnati. Both the district office and the new drive-in warehouse will be under the management of E. C. Bolton.

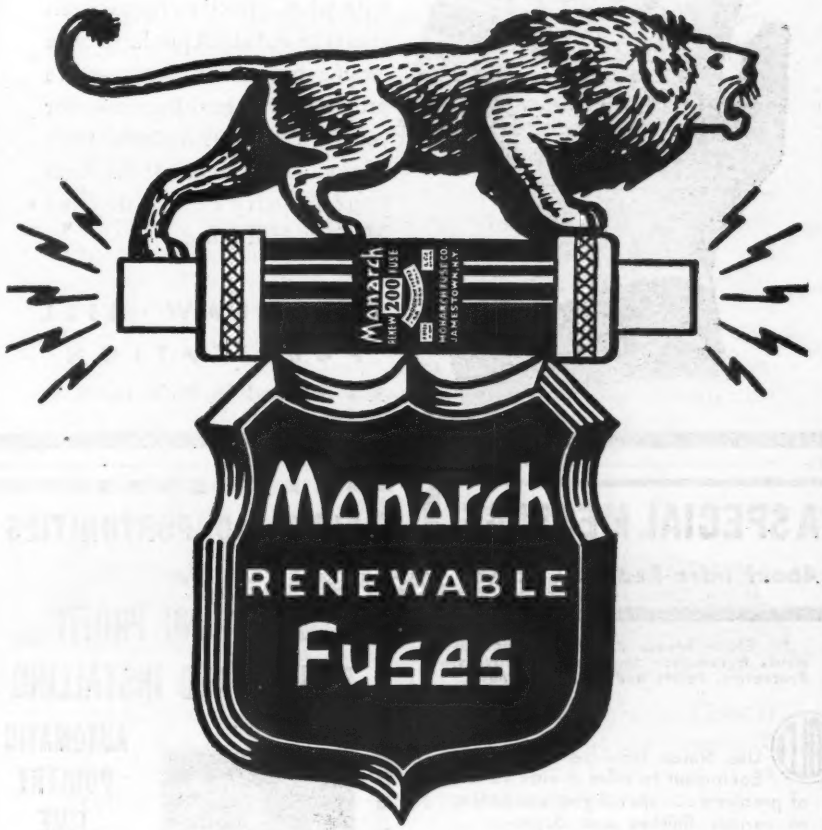
•

James Steel Mahan, Consultant, 201 North Wells Street, Chicago, Ill., has been retained by the following companies in an advisory and consulting capacity in connection with technical matters and engineering problems involving the use of porcelain insulated wiring; Ceramic Specialties Company, Illinois Electric Porcelain Company, Porcelain Products, Inc., Specialty Porcelain Works, Superior Porcelain Company and Universal Clay Products Company.

•

Penn-Union Electric Corporation, Erie, Pa., has promoted Fred T. Conboy to the position of sales manager. He succeeds George L. Clarke, who has moved to San Francisco, Calif., where he is now associated with the Penn-Union Sales Agency, F. M. Nicholas Company, 1123 Harrison Street.

Dependable Protection



MONARCH FUSE COMPANY, LTD.

116 E. FIRST STREET JAMESTOWN, N. Y.

Briefalog your line!

In 1945, they'll reach for

E-B-R

ELECTRICAL - BUYERS - REFERENCE

Your 1945 line in handy E-B-R *Briefalog* form will reach the men who plan, specify, requisition electrical and allied products. Save catalog production costs; assure proper coverage. Reprints for your own mailings available. 1945 edition closes Sept. 15th. Rush your inquiry to the nearest McGraw-Hill office.

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330 W. 42nd St., N. Y. 18, N. Y.

A SPECIAL MESSAGE

About Infra-Red Ray Drying

To Those Whose Production Requirements Necessitate the Use of Lacquers, Synthetics, Paints and Other Finishes

NALCO Use Nalco Infra-red Ray Drying Equipment to solve a wide variety of problems . . . spot drying and baking of various finishes and dopes . . . quick drying of varnishes and impregnating materials for motor windings and electrical and mechanical parts of all types.

NALCO DRITHERM LAMPS

- Will Cut drying costs and time.
- Eliminate "warm up" time.
- Require no enclosures nor ovens.
- Use a minimum of space.

Left—Nalco 5-light portable adjustable unit.

NORTH AMERICAN Electric Lamp Co.

1044 Tyler St. St. Louis 6, Missouri

DOUBLE OPPORTUNITIES for SALES AND PROFIT SELLING AND INSTALLING

AUTOMATIC POULTRY TIME SWITCHES for LIGHTING POULTRY HOUSES

Cash in on this profitable market! Every poultry raiser now knows that ***LIGHTS INCREASE PRODUCTION AND PROFIT.*** They all want these Poultry Time Switches. Sell them! Install them! The season's short. ACT NOW!

FOUR MODELS

$12.00 to $18.00

With and without "Dimmer Circuit"
All-electric and Manually-wound

Write for Information

AUTOMATIC ELECTRIC MFG. CO.

MANKATO, MINNESOTA

General Electric Company, Bridgeport, Conn., announces the appointment of G. R. Prout as manager of the air conditioning and refrigeration division of the appliance and merchandise department. He will be located at Bloomfield, N. J., where headquarters of the company's air conditioning and commercial refrigeration activities are located. Prior to his new appointment, Mr. Prout was manager of the industrial control division in the company's general office at Schenectady. He has been with G-E since his graduation from M.I.T. in 1923.

•

John C. Dolph Company of Newark, N. J. has announced the appointment of David M. Kelly to the engineering staff, in charge of the Industrial Service Division. He was formerly associated with the I.T.E. Circuit Breaker Company of Philadelphia, Pa.

•

The United States Rubber Company has established new manufacturing facilities in seven cities—Scottsville, Va.; Lowell, Mass.; Ligonier, Ind.; Worcester, Mass.; Manchester, N. H.; Grand Rapids, Mich.; and Beacon Falls, Conn.

•

The Apex Electrical Manufacturing Company has announced the appointment of A. C. Scott as vice president in charge of sales. Mr. Scott will direct all sales activities of the company plants at Cleveland and Sandusky, Ohio.

•

Kellogg Switchboard & Supply Company of Chicago, announces the appointment of F. M. Parsons as sales manager and C. D. Manning as executive assistant to the president.

•

McGraw Electric Company, Chicago, has named Allan C. Davey as sales manager of the Clark Water Heater Division with headquarters at the factory in Chicago. Mr. Davey was formerly sales manager of the Wisconsin Public Service Corp.

•

American Welding & Manufacturing Company, Warren, Ohio, has announced the appointment of Thomas F. Wood as supervisor of arc welding.

Loop Feeders for Air Depot

[FROM PAGE 55]

No. 6. Two 500 MCM paralleled feeders continue one leg of the loop through vaults 10, 12 and 13 to O.C.B. No. 5 of the main switching station thus completing part of the loop.

The other leg of the loop leaves vault No. 6 through O.C.B. No. 62 and continues through vaults No. 8 and No. 9 to O.C.B. No. 4 of the switching station completing the second leg of the loop.

Under normal operation all disconnects and breakers are closed and all feeders are hot and paralleled, and carrying its proportionate share of the load. The double-looping described above has added considerably to the capacity, flexibility and stability of the electrical distribution system.

In most instances, there is sufficient feeder copper on either or both sides of any vault that good voltage regulation is always obtained even during unusually heavy peak loading periods. In the event of a feeder failure, the loop type distribution has the advantage whereby all stations can be kept energized merely by switching "out" the faulty feeder until repaired, and feeding from the other direction.

Substation oil circuit breakers are provided with disconnects on either side so that breakers may be de-energized for maintenance. That is, an incoming feeder after emerging from the pothead, passes through disconnects, through O.C.B., through another set of disconnects and onto the station bus.

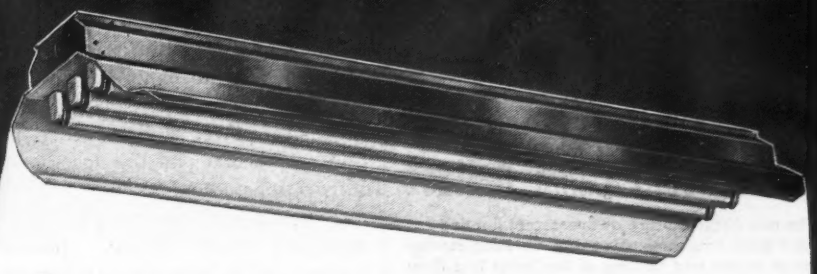
The station high voltage bus in general consists of 3,000 volt insulated wire mounted on the wall above the transformer banks and carried on either individual insulators or bakelite brackets. Both types can be seen in the accompanying illustrations. In certain of the higher-capacity stations copper tubing or busbar is used for the high voltage bus.

The transformer banks are in general made up of single phase units for both power and light. Power bank secondaries are three phase 230 volt while lighting secondaries are three phase, four wire 120/208 volt. Only one or two exceptions exist and these are certain instances where lighting transformers are connected straight single phase 120/240 volts.

Secondary power is collected from the respective light and power transformer banks by highly polished and

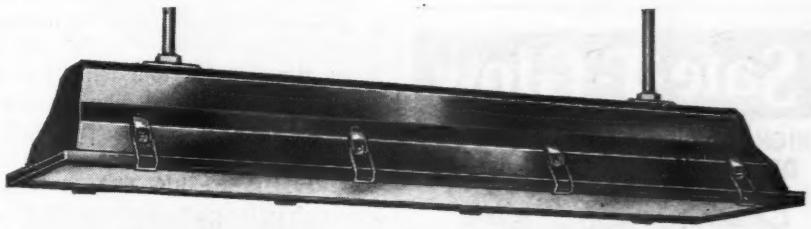
[Continued on page 168]

EQUIP YOUR PLANT WITH *Skilled Lighting* NOW!



In the light of wartime experience, progressive manufacturers have learned the vital importance of SKILLED LIGHTING to speed output and reduce accident. For better production *today* and better products *in peace time*, they are installing Wheeler-engineered fluorescent fixtures *now*.

This is especially true since Wheeler is back in production of the *all-steel unit* – highly-developed product of wartime research plus 63 years of lighting experience. Open-End *all steel* Fluorescent units are available for two 40-watt, three 40-watt and two 100-watt lamps. Units have a broad metal wiring channel, with easily-accessible, enclosed ballast. Can be mounted from chain or conduit, in individual or continuous runs. Messenger Cable, Rod, or Close-to-Ceiling Suspension fittings. Overall fixture efficiency of two 40-watt unit 80%, three 40-watt unit 74% and two 100-watt unit 71%.



ALL-STEEL DUST-TIGHT Fluorescent Fixture for Class II "Group G & F", and Class III and IV Hazardous Locations will prove as efficient and economical in peace time as it is in meeting wartime demands for SKILLED LIGHTING, where lamps, sockets and reflecting surfaces must be protected from dusts and vapors. Available for two or three 48-inch, 40-watt lamps.

These dependable units can be supplied with Double-Thick Plain Clear Glass, Water White Plate Glass or Tempered, Clear Safety Plate Glass, mounted in the hinged dust-tight cover.

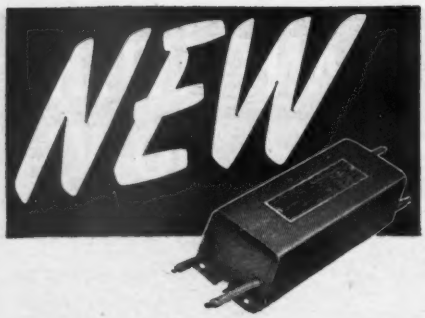
• • •

These are but two examples of the high-efficiency light engineering – SKILLED LIGHTING – which Wheeler has developed to give maximum visual aid to workers. Write for full details on the complete line of fluorescent and incandescent fixtures. Wheeler Reflector Company, 275 Congress St., Boston 10, Mass. . . . New York, N. Y. Representatives in principal cities.

Distributed Exclusively Through Electrical Wholesalers

Wheeler REFLECTOR COMPANY

Lighting Equipment Specialists Since 1881



QUICK-START
Fluorescent Lamp Ballast

The one disadvantage of fluorescent lighting has now been overcome. Time-lag between turning on of switch and lighting of the lamp is a thing of the past. The new Acme Quick-Start fluorescent ballast for use with "Instant-Start" fluorescent lamps eliminates the need for starters and provides instantaneous lamp light. For detailed information write for Bulletin 164.

Another New Advance in Cold Cathode Lighting

The new Acme *Cold Cathode* lamp ballast is designed for standard 93"—25 mm tubes. Keep informed on the new developments in *Cold Cathode* lighting. Write for Bulletin 165.

THE ACME ELECTRIC & MFG. CO.
CUBA, N.Y. CLYDE, N.Y.

Acme ACME Electric
TRANSFORMERS

Safe-T-Glow

SAFETY RULES call for that EXTRA precaution and additional RE-CHECK which SAFE-T-GLOW provides. Detects accidental tie-ins, crossovers, leakages and induced voltages . . . prevents serious injury and loss of life. SAFE-T-GLOW consists of a sensitive Neon tube, amplified by mirror reflector.

Model A 3-ft. handle
Model B 6-ft. added extension

Model A for circuits 2,000 to 35,000 volts.
Model B for circuits from 35,000 to 220,000 volts.

TEST-O-LITE

Tests Everything Electrical from 100 to 550 Volts

Equipped with Neon light which tells instantly where trouble lies in circuits, fuses, cut-outs, motors, etc. Indicates hot or grounded wires. Tells AC from DC. SAVES PRECIOUS TIME. Has PATENTED safety features. Vest pocket size with clip. Lifetime guarantee. List $1.50 (Priority A-7) Purchase thru regular electrical dealers.

L. S. BRACH Mfg. Corp.
55-63 Dickerson St. Newark, N.J.

Loop Feeders for Air Depot

[FROM PAGE 167]

lacquered busbar suspended by insulators from open pipe framework. The busbar drops directly into the secondary distribution panels and are connected to the panel busbars. This type of construction is used for feeding both power and lighting panels and may be seen in the accompanying illustrations.

Panels are of a multiple breaker type equipped with fusible protection. Power and lighting branch feeders are taken from a common junction box to panels at their various utilization points in parallel ducts. Distribution of branch feeders from vault No. 10 can be seen in the single line diagram of Fig. 2.

Grounding is obtained in all vaults and substations by a ring of No. 4/0 bare wire connected to an average of six driven one-inch copper rods. All equipment and lighting transformer wye mid-taps are connected solid to this ground ring-bus. Each manhole is also provided with a three-quarter inch driven ground rod, which ground is bonded to the lead sheathed cable.

The building lighting in the hangars, repair docks and test cells are fed from three-phase, four-wire 120/208 volt panels. General illumination is provided by all three general types of sources; fluorescent, incandescent and mercury. Low-ceilinged bays such as machining areas and the like are equipped with fluorescent; high-bay repair areas with mercury and warehouse areas and the like with incandescent.

The fence lighting circuit is 2400 volts single phase and is carried underground around the perimeter of the premises. The poles are spaced on 500 foot centers with a 7½ kva. single phase transformer located at every third pole. Each pole carries two angle reflectors equipped with 1500 watt lamps. The two poles on either side of the one at which the transformer is located, are fed through parkway cable laid under ground.

The runway lights, range lights and obstruction lights are fed through special low-voltage series circuits remotely controlled from the control tower. The series circuits are so arranged that all obstruction, range and runway lights, affecting a landing operation from any certain direction, are grouped so as to be controlled en masse.

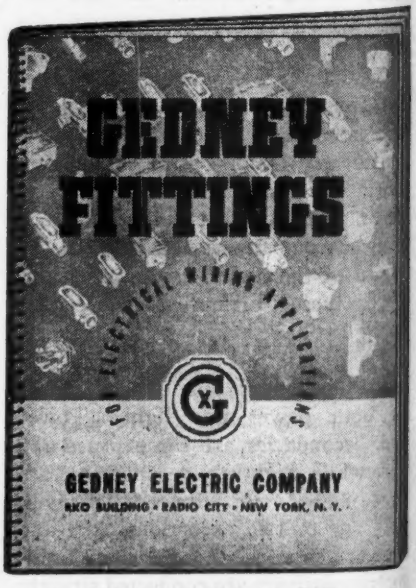
MULTI
Reflectors
FILL ALL industrial needs

War work comes first now, but this same war work has brought out and emphasized the need for good lighting in stores, plants, shops, offices, etc. Contractors who are acquainted with the MULTI line have a good start on that post-war lighting business that is sure to come. This is a complete line for commercial and industrial work.

• Send for catalog •

MULTI
ELECTRICAL MANUFACTURING CO.
1840 W. 14th St., CHICAGO, ILL.

SEND FOR THIS HELPFUL DATA ON
GEDNEY FITTINGS



"Gedney Fittings Fit"
SOLD THROUGH WHOLESALERS
GEDNEY ELECTRIC COMPANY
RKO BUILDING NEW YORK 20, N. Y.

Estimating Conduit Work—Part I

[FROM PAGE 46]

5. One branch cut and thread. (The conduit hook projecting through the form must be threaded to expedite "nipping out" later.)
6. One branch circuit or conduit terminal. (This labor item occurs at the ceiling outlet or junction from which the conduit is routed. It is not applied to the ceiling outlet labor since it occurs only where there is an additional conduit run for a wiring device.)
7. One branch circuit conduit offset.

The above items are all done prior to the concrete pour. Following the pour and removal of the forms, the following work would be done for the partition outlets.

1. Spot the outlet.
2. Nipple the conduit hook down to the outlet box.
3. One branch circuit conduit terminal.
4. One branch circuit conduit offset.
5. Install box. (In clay tile, brick, etc., box should be installed in the masonry and mortared in. In a wood stud partition a bar hanger would be required.)
6. Install plaster cover. (This material item would have to be selected after knowledge of the wall covering details.)
7. Install wiring device. (After plastering is completed, and wire has been pulled, the device and plate are installed. This item is listed with the outlet, rather than in a special "trim" schedule, to reduce the attendant "pencil" work. If there is a desire on the part of the estimator to segregate the "rough" and "trim" jobs the single unit which is allocated to the wiring device can be broken into 2 units.)

Table III lists the labor units for wiring devices installed in partitions and fed from a flat slab ceiling conduit installation. This table also includes units for common floor outlets.

The labor unit system described above attempts to minimize the number of units required. To properly use the system the material should be taken off in units and nomenclature that will make the labor entry relatively simple. A portion of a hypothetical take-off is illustrated in Fig. 1. In pricing his material the estimator can compile on the reverse side of his

[Continued on page 170]

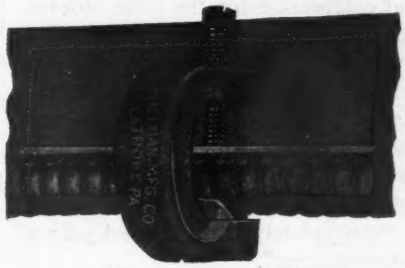
LATROBE PRODUCTS

FLOOR BOXES

WIRING SPECIALTIES

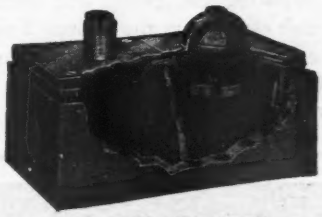
SAFE, STRONG, EASY TO INSTALL and ECONOMICAL

Latrobe Products are time-savers — a big and increasing factor these days. But of even greater importance is their high quality and superior performance. Right for emergency and routine jobs.

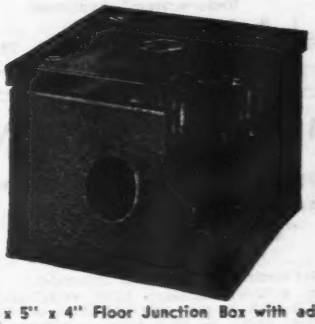


NO. 480 "BULL DOG"
Armored Cable Support
Light weight clamp of great strength for hanging armored cable to steel work. Convenient for temporary and permanent jobs.

NO. 284 NOZZLE
with No. 200 Cover Plate
Here is a neat and compact Duplex Receptacle Nozzle. Furnished with ½" or ¾" brass pipe extension.



NO. 252-R FLOOR BOX
This two-gang Box has one cover plate with ½" Flush Brass Plug and the other cover plate with 2" Flush Brass Plug.



5" x 5" x 4" Floor Junction Box with adjustable cover.

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Highest grade flat steel wire, properly tempered. Ten sizes, conveniently packed.

"BULL DOG"
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Excellent quality. Much in demand. Cartons, Kegs and Barrels.

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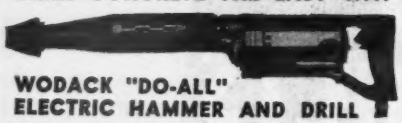

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ROCHESTER 1, NEW YORK
NEW AND REBUILT

Estimating Conduit Work—Part I

[FROM PAGE 169]

estimate sheet the aggregate material comprising one ceiling or receptacle outlet. This saves a great deal of duplication of minor material items and at the same time establishes nomenclature to which the labor unit can apply. It also provides a single dollar entry for each outlet (See unit price for ceiling outlet in Fig. 1.). If successful in obtaining the contract, the estimator can multiply the items making up the complete outlet by the quantity involved and order accordingly.

There will be minor changes in the construction problems which have been outlined. Many duplex receptacles will be turned up out of the slab, instead of down through the form to the floor below, etc. The units are consistent enough to use throughout, and compensate for the close observation during concrete pours necessary on this type of work. Special precaution should be exercised in fastening of couplings, connectors, locknuts and bushings. The conduit itself must be bound to the steel and supported well enough to permit a flow of concrete completely around it and yet prevent "floating".

The principles and units described heretofore will apply to branch circuiting in "pan" construction, and "tile arch" construction, except for certain labor unit changes in the outlets. These will be discussed in detail in a second article to appear in a future issue of *Electrical Contracting.*

PREDICTION—House wiring will be one of the electrical contractor's principal operations in the future, warns T. J. Reneberg, manager, Martin Wright Electric Co., San Antonio, Texas. This subject warrants immediate thought, he told the South Texas Chapter, NECA, at a recent meeting in San Antonio.

How the electron works for you

Here is the kind of book you have been awaiting—an ABC book which will show any electrical worker or salesman of electrical supplies what electronics is all about. This book gives you simply—without formulas or much mathematics just what you want to know about electronic principles and how they are applied in working devices.

A PRIMER OF ELECTRONICS

By DON P. CAVERLY
Commercial Engineer, Sylvania Electric Products, Inc.

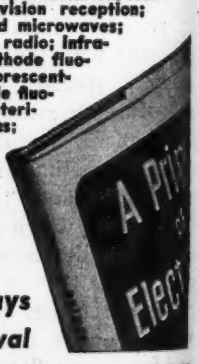
235 pages, 5½ x 8½, illustrated, $2.00

Here is an especially clear and simple explanation of electronics and electronic tubes and circuits, for all concerned with the manufacture, application, or operation of household or industrial electronic devices.

- **The text is concise and written in language that anyone can understand, yet is technically authoritative and complete.**
- **More than 200 specially prepared illustrations are an important factor in the clarity of the treatment.**
- **The material has grown out of the widely-known series of articles in *Wholesaler's Salesman.***

The book begins with the atom, the electron, and static and electron discharges and takes the reader step by step through explanation of electric current, magnetism, and electromagnetic radiation, to an understanding of simple radio tubes, fluorescent lamps, cathode ray tubes, ignitron, thyratron, and other tubes and their basic connections for practical purposes.

The book covers concisely, practically, so that any one may understand, such topics as: production of radio waves; reception of radio waves; short-wave radio; frequency modulation; television transmission; television reception; ultra-high frequencies and microwaves; ranging and directing by radio; infrared; ultra violet; hot cathode fluorescent light sources; fluorescent-lamp circuits; cold cathode fluorescent light sources; bactericidal tubes; strobotrons; photo-electric tubes; cathode-ray tubes; iconoscopes; image-dissector tubes; facsimile recorder tube; X-ray tubes; electron microscope; electron tubes in general.



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D.C. to A.C. Changeover

[FROM PAGE 60]

against slipping of a threadless joint, each was drilled to accommodate a cotter-pin as positive assurance against the fixture dropping off the end.

In certain isolated areas such as the foundry, deep dome mercury units were used and equipped with diffusing rings, because of the lower mounting heights. Tulamp 230-volt auto-transformers were used with the mercury units.

The low side-bay areas are equipped with 200 watt, 230 volt fluorescent units. The reflectors are hung parallel to the conduit which is utilized in hanging them. Strap clamps on the conduit are attached to suspension chains which support the fixture. In the conduit is inserted a T-conduit fitting, with a cord drop, and which is drilled and tapped for a fixture ground connection. A three conductor No. 18 drop cord is used from fitting to fixture.

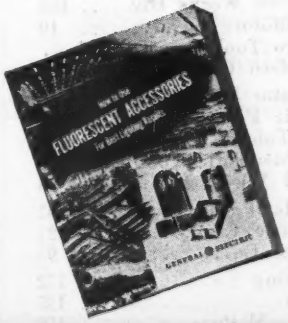
Daylight tubes were selected for the fluorescent lamps since they gave the best transition effect from the mercury to the fluorescent. Mounting dimensions of the fluorescents are: 8 feet by 12½ feet on centers at a mounting height of 16 feet.

The motor load consisting mainly of 5, 15, 25 and 30 hp. motors included not only new additional load, but also whatever old load could be found that was adaptable to constant speed drive and ready changeover. The 250 hp. (approx.) motor load is fed by a No. 3/0 power feeder which runs the length of the plant in open wiring on three spool racks and parallel to the lighting feeder. Like the lighting distribution, the power circuits emanate from the trusses. Fuse panels are mounted on the building structure steel work near the feeder (as in the accompanying photo). Taps enter the boxes through Federal bushings and branch circuits continue to the motor safety switches at a readily accessible location near the motor.

Maintenance superintendent Voslamber, who designed the a.c. system to conserve as much critical material as possible is well pleased with the open wiring feature. Even with plenty of material available, it will still be open-wiring from now on because of its flexibility and the ease with which additions and changes can be made. New loads can be added by merely installing a fuse panel in the trusses and tapping into the power feeder.

Reset It Forget It

HERE'S how the Watch Dog Fluorescent Starter simplifies lighting maintenance. When a lamp dies the Watch Dog automatically cuts itself out of the circuit stopping annoying blink and flicker. The manual reset button pops up preventing futile and needless starting attempts. Then the maintenance man can replace the burned-out lamp at his convenience. He merely presses in the red button, inserts a new lamp and the lamp immediately begins to operate normally. It's as simple as that. Just reset it and then forget it.



This new catalog tells how to use G-E Fluorescent Accessories for best lighting results. You can obtain your free copy by writing to Section G842-8, Appliance and Merchandise Dept., General Electric Company, Bridgeport, Conn.

★ BUY WAR BONDS AND KEEP THEM ★

Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. EWT, CBS.

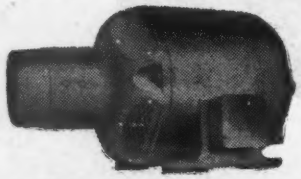
GENERAL ELECTRIC

KATOLIGHT A. C. GENERATORS

Furnish Same Current as City Power Lines

Kato Engineering products are carrying out an important job in the War Effort.

A maneuvering fighting force cannot arrange for a power line hook-up. KATOLIGHT GENERATORS furnish electricity on the field of battle which permits equipping our fighting forces with the most modern electrical appliances.



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Fighting forces need guns, planes, tanks, trucks, kitchens, emergency hospitals, lights, etc. To keep this equipment going, complete repair equipment such as drills, grinders, saws, air-compressors, etc., are needed. Standard A.C. electricity, the same as you get from the power line, must be had for operating these devices. Portable KATOLIGHT GENERATORS supply this electricity. They also supply current for radio transmitters, beacons, landing field controls, etc.

Available in all standard voltages and sizes up through 25,000 watts. Also manufacturers of rotary converters, frequency changers, motor-generators, gas engine driven battery chargers, high frequency motor-generators, and converters.

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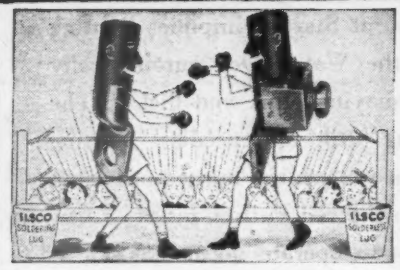
Electrical Connectors



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FOR FURTHER INFORMATION on Flamenol Building Wire, Type SNW or Type SN or on conduits or wiring devices, see the nearest G-E Merchandise Distributor or write to Section CDW 841-8 Appliance and Merchandise Dept., General Electric Company, Bridgeport, Connecticut.

ON ADEQUATE WIRING

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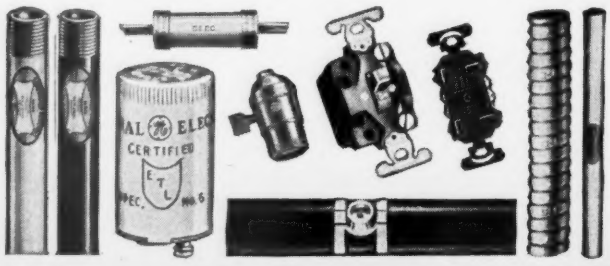

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